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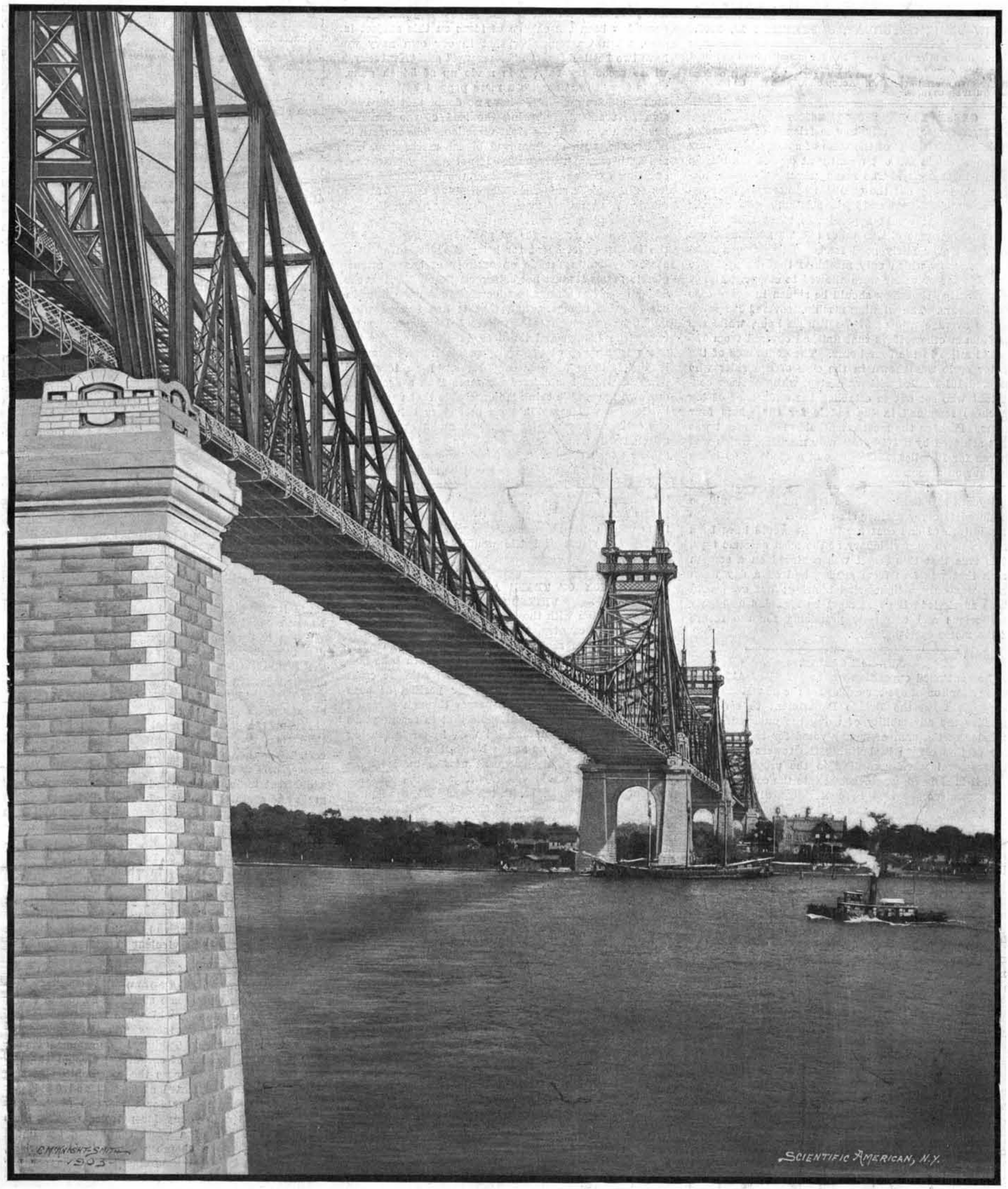

THE NEW BLACKWELL'S ISLAND BRIDGE, NEW YORK CITY, NOW UNDER CONSTRUCTION.

Total length, 7,636 feet. The two river spans are 1,182 feet and 984 feet in length.—[See page 202.]

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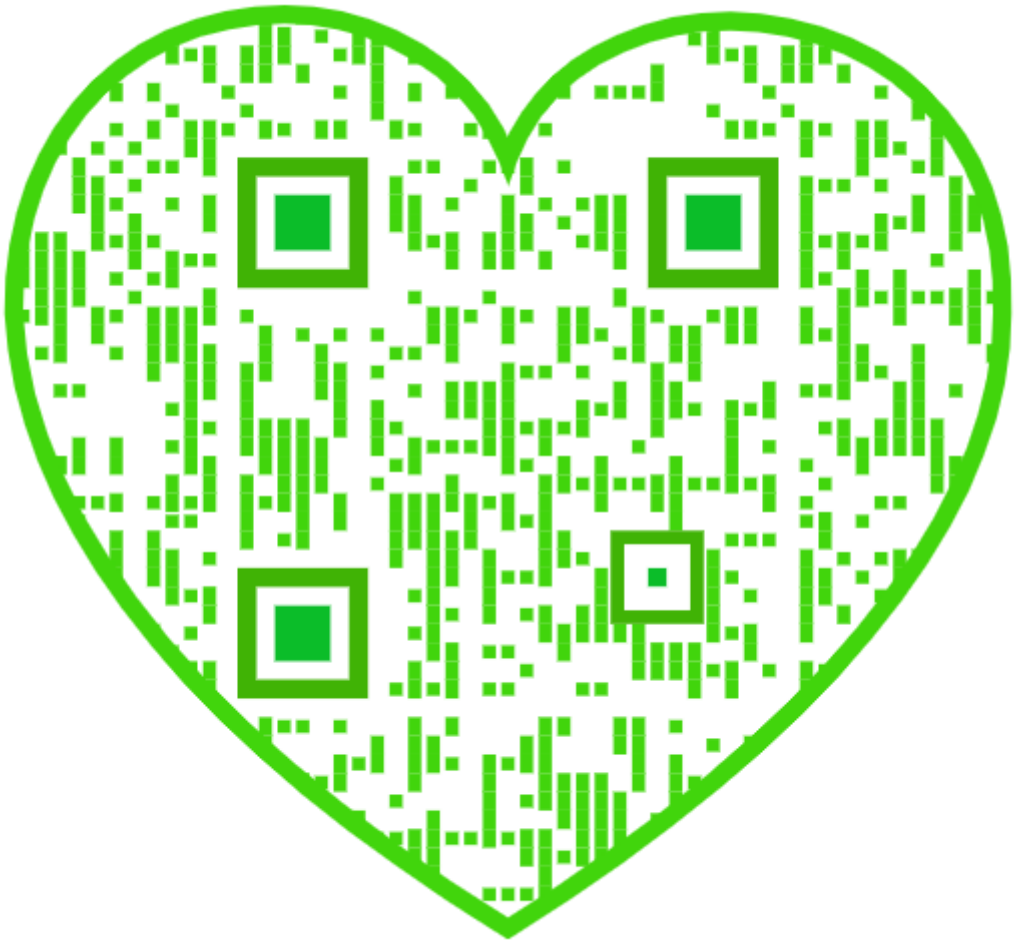

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, SEPTEMBER 19, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

GREAT ECONOMY OF THE MOTOR CYCLE.

Extremely satisfactory to the friends of the motor cycle was the result of the tests of speed and economy which were carried out recently at one of the bicycle tracks in this city. The management very wisely determined to try out the qualities of normal motor cycles of standard make and reasonable horse power under conditions that would approximate those that obtain when any private citizen takes out his machine for a day's run over fairly good roads. There was a four-hour race, in which only machines that were of five horse power or under were allowed to compete, and it was required that they should be ridden in every case by amateurs. The winning machine covered 150 miles at the average rate of 37½ miles an hour, while the half dozen other riders that finished covered from 115 to 142 miles in the four hours. The endurance of the motor cycle was shown in the case of one rider who covered 131.3 miles without a stop, while another contestant who set out to establish the endurance of his machine remained in the saddle for the whole four hours. Perhaps the most remarkable result of all was that achieved by a 1¾-horsepower machine, which was driven for 19 miles, 1348 yards, at a speed of 30 miles an hour on a consumption of only one pint of gasoline that cost about three cents. If any one had foretold two years ago that a motor-driven machine would be produced to carry a rider six and a half miles for the expenditure of one cent for fuel, he would have been written down as a visionary of the most extreme type. It is true that this result was achieved on a smooth track that was free from grades, and on a day when there was only a light wind blowing; but even with these admissions the feat must be regarded as highly meritorious and extremely promising for the future of the motor cycle industry.

EYE-BAR CABLES.

The continued opposition of the Board of Aldermen to the adoption of eye-bar cables for the new Manhattan Bridge has led the Bridge Department to seriously consider the advisability of using the unexpended remainder of the sum of money voted for the construction of this bridge in building the towers and other substructural work according to the proposed plans. This, it is claimed, would necessitate the completion of the superstructure also in conformity with the proposed plans. We doubt the wisdom of such a course, for the reason that the Board might maintain its opposition to the eye-bar cables and precipitate a deadlock, of which no one could foretell the end. We have already pointed out in this journal that the objections to the eye-bar are either sentimental or fanciful. Not only is there no valid engineering objection that can be raised against them, but they have, in this particular design, certain merits, both of appearance and economy of material and time, which should lead to their immediate adoption. Because we have been building long-span suspension bridges of wire for so many years is no reason whatever why we should continue to build them on this system indefinitely. Indeed, judged from the purely American standpoint, its long-continued use furnishes a good reason why we should investigate the system to see if it cannot be improved upon. The eye-bar method of construction is distinctively an American creation. We have developed it until the eyebar bridge has come to be regarded as the distinctively national type. No one has heard a word of objection against the Blackwell's Island Bridge, in which the eye-bar figures just as extensively as it does in the proposed Manhattan Bridge. The functions, the shape, and the stresses to which they will be subjected, are broadly similar in both bridges, and the opponents of the type have yet to present an objection to their use in the new Manhattan Bridge either from the standpoint of architectural effect or engineering utility which will stand the test of impartial investigation.

INTERMEDIATE BATTERIES ON BATTLESHIPS.

The latest announcement of the designs of the new Russian battleships is that they are to carry four 12-inch and twelve 8-inch guns as their principal armament. The 12-inch gun appears to be thoroughly well established as the proper piece to mount in the main battery of the modern battleship; but for the secondary battery there has been, and still is, a wide diversity of opinion as to the best type of gun. In all navies there is a growing tendency to increase the weight of the secondary pieces and provide guns that are armor-piercers at ordinary battle ranges. Until lately the 6-inch gun was the popular secondary-battery weapon. Then Great Britain brought out her 7.5-inch gun, and the United States her 7-inch gun, to be followed a little later by Italy, which, in the "Vittorio Emanuele," boldly adopted a secondary battery made up exclusively of long-caliber, 8-inch rapid-fire guns. How great has been the change of ideas on this subject is seen, when we remember that in our own navy we have two battleships, the "Kearsarge" and "Kentucky," whose secondary battery is made up of 5-inch guns, while the "Iowa" carries a mere popgun battery of 4-inch rapid-fire guns. We have no doubt that the Russian government, following the lead of the Italians, has taken a step in the right direction. The modern 8-inch piece, with its improved breech mechanism, can fire with a rapidity equal to if not greater than that of many existing 6-inch guns in the rapid-fire batteries of the older ships, and its striking energy at the more distant ranges is so much greater than that of the 6-inch piece as to render it an incomparably more effective gun, weight for weight. In giving credit to the Italian government for being the first to adopt a secondary battery made up entirely of heavy armor-piercing guns, it must not be forgotten, however, that the 8-inch piece has always been carried in our warships in considerable numbers, and that it has formed what might be called an intermediate battery midway between the 12-inch and the 5 or 4-inch battery, as the case might be; so that in using an 8-inch gun exclusively the Italians have merely developed an idea, the germ of which has existed for more than a decade in our own navy. We think it is probable that our future battlesbips will carry in their secondary battery only one caliber of armor-piercing guns, and that the piece selected will be either the 8-inch or some new gun of 8½ or 9-inch caliber. The 6-inch gun will disappear altogether, and the 14-pounder will be used exclusively for the third or rapid-fire battery. This would result in a simplification of the arrangement of ammunition rooms and hoists, and as there would be only three calibers of gun, the chances of confusion of ammunition during the stress of battle would be proportionately reduced.

DISTRIBUTION OF TRADE AT THE PORTS OF THE UNITED STATES.

In connection with the steady increase in the export trade of this country, it is interesting to know that there is a more rapid growth of trade at the ports located on the Gulf of Mexico, the northern lake border and the Pacific coast than at the Atlantic coast ports. Although by far the larger portion of both the export and import trade passes through ports on the Atlantic coast, it is noticeable that in recent years the export trade is finding its way, in an increasing proportion, to the ports at the North, South and West, although about eighty per cent of the total import trade still enters this country through the Atlantic seaboard. As compared with the year 1901, the figures for the fiscal year just ended show a reduction of exports for Boston of 55 millions; for New York, of 24 millions; for Philadelphia, 6 millions; Baltimore, 25 millions; Newport News, of 7 millions, and for Norfolk a reduction of nearly 2 millions. As we continue southward down the coast, we find that there is an increase in exportations at Savannah of about 8 millions; at Wilmington, N. C., of over 2 millions; and at Galveston, an increase of 3 millions. Combining all of the Atlantic ports, the total exports of 1903, compared with those of 1901, show a falling off of 98 millions; while the figures for the Gulf ports are about the same in 1903 as in 1901. The exports of the Mexican border ports have increased nearly 5 millions, and of the Pacific ports about 10 millions; while the northern border and lake ports show an increase of 18 millions. In imports, however, the Atlantic seaboard is increasing its commanding lead. In the year 1903, out of the total imports into the United States of 1,025 millions, eighty per cent came in through the Atlantic ports. A comparison of the figures for 1903 with those of 1901 shows that there has been an increase of 151 million dollars at the Atlantic ports, 12 million dollars at the northern ports, 8 million dollars at the Pacific ports, and 25 million dollars at the northern border and lake ports. A comparison of the growth of the past ten years shows that whereas in 1893 the total of exports of New York amounted to 347 millions, in 1903 they had grown to 505 millions, an increase of 158 millions; while the imports had grown in the same period from 548 millions to 618 millions. A truly remarkable story of commercial development, and one without a parallel in the history of the world.

THE CAUSE AND CURE OF HAY FEVER.

Hay fever is a catarrhal affection of the eyes, nose, and throat, accompanied by violent sneezing and asthmatic symptoms, to which very many persons are subject in the summer while others are entirely immune. The attack commonly begins in the latter part of May and continues six or eight weeks.

Medical treatment has hitherto been of little use. The best palliative is a trip to the seashore.

Until recently there has been great uncertainty as to the cause of the disease, which has been variously attributed to the heat of early summer, exhalations from grass and new-mown hay, mechanical irritation by pollen from grasses and other plants and, recently, to bacteria.

Prof. Dunbar, of Hamburg, who has been studying the subject for seven years, now publishes, in the Deutsche Medizinische Wochenschrift, experiments which seem to disprove all these theories and also to hold out the hope of curing hay fever by a rational treatment.

According to Dr. Dunbar, the disease is caused by the pollen of grasses, but not by mechanical irritation. He has extracted from the pollen a poison, or toxin, which is insoluble in ether and alcohol, but soluble in water and weak saline solutions, tears, the mucus of the nose and the serum of blood. A solution of this toxin dropped into the eye or nose at once produces the characteristic symptoms of hay fever. The same symptoms in an aggravated form occur when the solution is injected hypodermically.

This discovery suggested treatment by the serum method and Dr. Dunbar set to work to produce a curative serum by inoculating animals with pollen toxin. For several months these animals yielded a blood-serum which aggravated instead of relieved the sufferings of hay fever patients, but in time counter-poisons were formed in the blood of the inoculated animals and a serum was obtained which, when dropped into the eye or nose together with pollen toxin, completely prevented the attack which the latter alone would have caused.

Experiments looking to the cure of the disease began in the latter part of January of the present year. A drop of very active pollen toxin was applied to the eye, and, as soon as the first inflammation appeared, a drop of the serum was applied. The burning sensation ceased instantly, but soon returned. Then a second drop of serum was applied, with similar results. After four drops had been thus given at intervals of five minutes the burning did not return and the redness and inflammation ceased.

When the applications were made to the nose the curative effect was even more strongly marked, because larger quantities of the antitoxin serum could be used.

There is therefore good reason to believe that the disease can be checked in its earliest stage by applying the serum to the external mucous surfaces. Hypodermic injection of the serum would probably be necessary if considerable quantities of pollen toxin had already passed into the blood.

Probably a more powerful serum can be obtained than was used in these experiments. It is not yet certain whether there is a single pollen toxin, a single variety of hay fever, and a single curative serum, or a different toxin, disease, and serum for each kind of grass and grain. Dr. Dunbar has proved, however, that serum from animals inoculated with maize pollen is efficacious against hay fever caused by rye pollen.

It is noteworthy that rye, barley, wheat, rice, maize, and every kind of grain and grass which Dr. Dunbar has investigated yield a toxin which causes hay fever, while, on the other hand, he has not succeeded in obtaining such a toxin from any plant not of the grass family (Graminiæ).

The toxin is permanent and, as the above-mentioned experiments show, is as virulent in winter as in summer.

ALCOHOL AS AN ILLUMINANT.

L. Denayrouze gives some statistics as to the use of alcohol as an illuminant, which has recently been rendered practicable by an increase in the efficiency of the Denayrouze lamp. Taking 1.08 gramme of pure alcohol or 0.64 gramme of carbureted alcohol (*alcohol carburé*) per candle hour as the consumption of this lamp, the cost is estimated at 0.00478 and 0.00298 of a penny per candle hour for these two alcohols, as against 0.01428 of a penny for petroleum. The lamp consists essentially of a wick, conducting the liquid by capillarity into a chamber where it is vaporized, the necessary heat being produced by a copper bar which derives its heat from the lamp itself. The vapor passes through a small channel into a kind of Bunsen burner, above which the mantle is fixed. The series of operations is entirely automatic.—Bull. French Phys. Soc.

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EXPANSION OF ELECTRIC RAILWAYS IN MASSACHUSETTS.

BY ALTON D. ADAMS.

Expansion of electric railways as to length of tracks, investment, gross and net earnings during 1901, in this State, was greater than that of any other year. For the twelve months ending September 30, 1901, $14,896,088 were added to street railway investments, and 264 miles of main track were laid within the State. During this same period the gross earnings increased $1,766,700 and the net earnings $361,506 over the corresponding sum for the previous year. These results were reached by additions of 11,254,457 to the number of car miles of operation, and of 38,499,737 to the number of passengers carried during the year of 1900. The general characteristics of street railway development since 1889, when electric traction began to displace horses, have been an increasing yearly addition to investments, equipments, service rendered, and net earnings. These characteristics are all present in the returns of 1901. Another accompaniment of the physical changes in street railways has been the decline in the ratio of operating expenses, and the rise in the ratio of net earnings, to gross income.

During the year under consideration interurban lines were the most marked feature of street railway development, the 264 miles of main track added amounting to 13 per cent of the total length in 1900.

EQUIPMENTS AND OPERATION OF STREET RAILWAYS IN 1900 AND IN 1901.

	Year of 1900.	Year of 1901.	Difference.
Miles main track	1,913	2,177	264
Number of cars	6,531	6,997	466
Number of motors	9,545	11,284	1,639
Investment	$84,715,097	$99,611,185	$14,896,088
Car miles	81,750,768	93,005,225	11,254,457
Employes	12,766	14,749	1,983
Passengers	395,027,198	433,526,935	38,499,737
Gross earnings	$19,999,640	$21,766,340	$1,766,700
Net earnings	6,839,693	7,201,199	361,506
Operating expenses	13,159,947	14,565,141	1,405,194

This increase in length of tracks accounts in large part for the rise of investments by 17 per cent, and also for the fact that operating expenses went up 10 per cent, while gross earnings gained only 8 per cent.

PER CENT OF INCREASE FOR EQUIPMENTS AND OPERATION DURING 1901 OVER 1900.

	Per cent Increase.		Per cent Increase.
Miles main track	13	Employes	15
Number of cars	7	Passengers	9
Number of motors	17	Gross earnings	8
Investment	17	Net earnings	5
Car miles	13	Operating expenses	10

As might be expected, the 9 per cent of increase in the number of passengers was less than the addition of 13 per cent to car miles, or of 15 per cent to employes, occasioned largely by the new lines. The car miles increased at the same rate as the length of main track, showing that the rate of track operation was just maintained. It is interesting to note the continued movement toward double motor equipments, as illustrated by the addition of 17 per cent to the number of motors, and only 7 per cent to the number of cars. The replacement of single by double-motor equipments is made evident by the fact that the increase in the number of motors was 1,639, while the like number for cars was only 466.

In order to bring out the great changes that have taken place in the physical and financial operations of street railways, since the introduction of electric traction on a commercial basis, in 1889, the figures for investments, equipments, and operation, in the years of 1888 and 1901, are here compared. In each case the figures for the fiscal year of 1901 are divided by the like figures for the fiscal year of 1888.

EQUIPMENTS AND OPERATION OF STREET RAILWAYS IN 1888 AND IN 1901.

	Year of 1888	Year of 1901.	Ratio.
Miles main track	533.59	2,176.98	4.07
Number of cars	2,588	6,997	2.70
Investment	$17,237,100	$99,611,185	5.77
Car miles	23,244,767	93,005,225	4.00
Employes	5,531	14,749	2 66
Passengers	134,478,319	433,526,935	3.22
Gross earnings	$6,824,317	$21,766,340	3.18
Net earnings	1,291,520	7,201,199	5 57
Operating expenses	5,532,797	14,565,141	2.63

By these divisions the ratios of the several quantities in the years named are determined. This comparison brings out strongly the main differences between the conditions and results with horse and electric traction, because 1888 was the last year in which horses held the entire field.

The most striking figures indicative of the change from horse to electric traction are those for investments, which were multiplied 5.77 times during the period under consideration. Next to investments in relative increase came the net earnings, which were 5.57 times as great in 1901 as they were in 1888. The miles of main track owned by the street railway companies were 4.07 times as great in the later as in the earlier year, while the car miles of operation were just quadrupled. Passengers show the next greatest relative increase, having been 3.22 times as numerous in the later year. Gross earnings have followed closely the increase of passengers, with a ratio between the sums for the two years of 3.18, showing that the income per passenger has remained nearly constant.

The multiplication of cars, employes, and operating expenses has gone on more slowly than that of the other factors in street railway development. Cars were increased to 2.7, employes to 2.66, and operating expenses to 2.63 times their former figures, in 1901. This brings out the reasons that have made the superior service of electric traction possible without an increase of fares, namely, that while larger investments have become necessary to perform a given amount of transportation work, these investments have brought with them lower operative costs.

Further light is thrown on the changes in connection with street railways since 1888, by comparisons of the relative as well as the absolute items of equipment and operation. Starting with the investment per mile of main track, which stood at $32,304 for the horse lines of 1888, the figure of $45,757 in 1901 shows an increase of 41 per cent with electric traction. The length of yearly travel per car with the increase of cars has just about kept pace with track extensions, as may be seen from the fact that the car miles per track mile in 1901 were 99 per cent of what they were in 1888. Density of traffic has necessarily fallen off with the great extension of interurban lines, and this has brought the number of passengers per mile of main track in 1901 down to 79 per cent of the like number in 1888. In the earlier year, the net earnings per mile of main track were $2,420, but in the later the corresponding amount was $3,308, an increase of 36 per cent.

MILES OF MAIN TRACK, CARS, CAR MILES, AND PASSENGERS IN RELATION TO OPERATION.

	Year of 1888.	Year of 1901.	Ratio.
Investment per mile of main track	$32,304	$45,757	1.41
Car miles per track mile	43,562	42,722	0.99
Passengers per mile main track	252,023	199,141	0.79
Net earnings per mile main track	$2,420	$3,308	1.36
Car miles per car	8,941	13,292	1.48
Net earnings per car	$499.04	$1,029.18	2.06
Passengers per car	51,960	61,958	1.19
Electric motors or horses per car	4.40	1.61	0.36
Net earnings per car mile	$0.0556	$0.0774	1.39
Passengers per car mile	5.7	4.6	0.80
Gross earnings per car mile	$29.36	$23.40	0.79
Expenses per car mile	23.80	15.66	0.65
Gross earnings per passenger	0.0507	0.0502	0.99
Expenses per passenger	0.0411	0.0336	0.81
Net earnings per passenger	0.0096	0.0166	1.72
Investment per passenger	0.12	0.22	1.83
Passengers per employe	24,313	29,393	1.20
Expenses divided by earnings	.8107	.6692	0.82

The average miles of travel for each electric car in 1901 were 48 per cent greater than the travel of each horse car in 1888. Net earnings showed an even greater rise per car, standing for the later at 2.06 times this amount in the earlier year. Passengers per car show only a moderate increase of 19 per cent during the period. Each car required 4.4 horses when they furnished the energy for traction, but the average motors per car in 1901 was 1.61, or 36 per cent of the number of horses per car, previously in use. The results of greater economy in operation are seen in the increase of net earnings per car mile by 39 per cent during the period under consideration, in spite of the fact that the number of passengers declined 20 per cent, and the gross earnings per car mile 21 per cent during the same years. To bring about these results, the reduction of operating expenses per car mile in 1901, to 65 per cent of what they were in 1888, was necessary. Though the average length of travel for each passenger has materially increased, the rate of fare has remained nearly constant, as shown by the fact that gross earnings per passenger ended the period at more than 99 per cent of the figure at the beginning. Operating expenses per passenger show a decline of 19 per cent, and this explains the increase of net earnings from 0.96 to 1.66 cents per passenger, a rise of 72 per cent. In the year 1888 the street car systems had an investment of 12 cents for each passenger carried, but during the year of 1901 the like investment was 22 cents, or 183 per cent of the sum in the earlier year.

The electric system of street car traction has cut down the ratio of employes to passengers, so that instead of one employe to every 24,313 passengers, as in 1888, the number of passengers per employe was 29,393, in 1901. This reduction in the relative number of employes is one of the ways in which the electric system has cut down operating expenses.

In 1888, 81 per cent of the gross earnings were consumed by the operating expenses, but for 1901, with electric traction, the operating expenses fell to 66.9 per cent of the earnings. In other words, the ratio of operating expenses to gross earnings was only 82 per cent as great with electric as with horse traction.

SCIENCE NOTES.

A small specimen of radium was recently put on exhibition at the American Museum of Natural History, and has attracted wide attention. The specimen weighs about two grains, and was shown in the gem room on the fourth floor of the building. The two grains cost about $300.

From investigations carried out by J. Elster and H. Geitel, it would seem that cave and cellar air acts as if it were itself radio-active or had become so. Air aspirated from rock-masses is specially active. Masses of air absorbed under the earth's surface must therefore be exercising an influence upon our atmosphere, ionizing it and the like.

It is gratifying to note that Lieut. Peary has received a leave of absence which will allow him to carry out his cherished hope of another trip in search of the pole. Instead of relying upon sails as the chief part of motive power, the explorer will depend almost entirely upon steam, sails only being used as an auxiliary. Peary's plan is to make his base on Grant Land, and winter at Cape Columbia, or some part further west. Some of the Eskimos will transport his party across the hummocky ice that exists between the 83d and 86th degrees of latitude. The men who are to make the dash for the pole are not to engage in any of this toilsome work, but are to preserve their energies for the last stage, which will be 300 miles long. The expedition will be small. In all probability it will not number more than twenty-five men.

The manatee which has lately been added to the Zoological Society's living collection is an animal of much interest, as it does not belong to the ordinary species of the American coasts, but is a representative of the smaller form (*Manatus inunguis*) which is confined to the fresh waters of the Amazon. Here it was first discovered by the Austrian explorer, Natterer, in the Rio Madeira, in 1830, and designated *inunguis* from the complete absence of nails on the hand, which are always present in *M. americanus*. A single living specimen of the same form was previously received by the Zoological Society in 1896, and its anatomy was described by Mr. Beddard in the Proceedings of the Zoological Society for 1897. The present manatee, which is a young animal about three feet long, has been placed in one of the tanks in the reptile house, and is fed principally upon lettuce. An excellent colored figure of the marine manatee, based upon life-sketches made by the late Joseph Wolf, will be found in the mammal volume of Salvin and Godman's "Biologia Centrali-Americana."—Nature.

Morse and Frazer have conducted experiments on the measurement of high osmotic pressures, the specially constructed porous cells employed being made of fine materials, very uniformly mixed and hard burned, and semi-permeable membranes being produced in them by electrolysis. The electrical resistance of the membranes so obtained varied very considerably, the lowest resistance being about 3,000 ohms and the highest more than 200,000 ohms. The observations made show that high-resistance membranes are requisite for successful osmotic-pressure measurements, but no certain method of obtaining such membranes has been discovered. Experiments were carried out with half-normal and normal cane-sugar solutions. For the former the osmotic pressure was found to be about 13.5 atmospheres, and for the latter a lower limit of 31.4 atmospheres was determined. This osmotic pressure of more than thirty atmospheres was developed within two hours of commencing the experiment, and the membrane within the cell had a resistance of more than 200,000 ohms.—Amer. Chem. Jour.

Messrs. E. Rutherford and A. G. Grier, in a recent paper on the subject of deviable rays of radio-active substances, state that uranium, thorium, and radium emit both deviable and non-deviable rays, the proportion of deviable rays being largest in the case of uranium. Polonium, on the other hand, gives out no deviable rays. The active products separated from uranium and thorium contain all the substance responsible for the deviable rays, while the original radio-active material still retains the power of emitting in the case of uranium a large proportion, and in the case of thorium 30 per cent, of the non-deviable rays. The authors think that most of the deviable rays from uranium and thorium may be given out by a secondary product, derived by disintegration from the uranium or thorium molecule; the difference in properties between these secondary products (uranium X and thorium X) and the original substances renders their separation possible. The non-deviable rays may be due to the other secondary product, or to an inductive action of UrX or ThX on the mass of the radio-active material.

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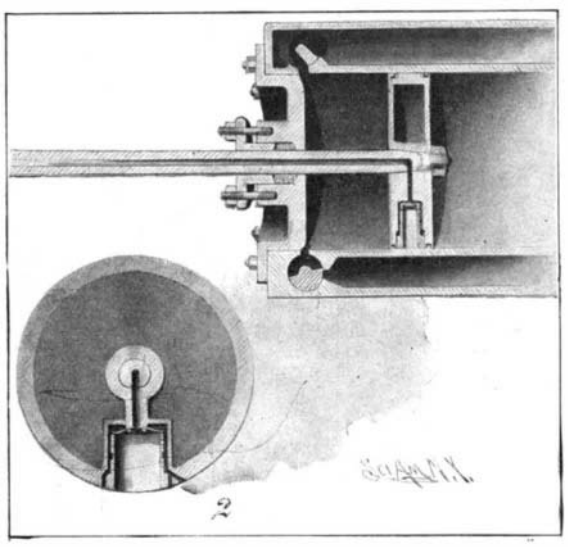
A FLOATING PISTON.

A recent invention provides a simple and effective means for sustaining the weight of a piston in a horizontal cylinder so as to reduce friction to a minimum and prevent the cylinder from wearing oval, which would cause leakage of steam or other fluid from one side of the piston to the other. The accompanying

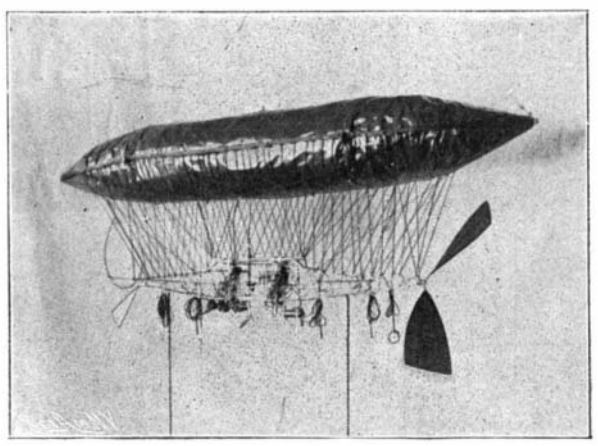


A FLOATING PISTON.

illustrations show clearly the means provided, Fig. 1 being a longitudinal section through the center of the cylinder and piston and Fig. 2 representing a transverse section through the piston head. It will be observed that the piston rod is hollow and connects with a passage extending at right angles therewith to a chamber opening onto the peripheral face of the piston head at its lower side. Steam or air is admitted to this passage through the hollow piston rod, and this pressing against the cylinder sustains the weight of the piston head. In order to prevent the escape of the fluid from the pressure chamber, the latter is provided with a sleeve having a packing ring and an enlarged lower portion adjacent to a vent tube formed in the piston head and leading to the peripheral face thereof, to lessen the pressure per square inch on the bottom of the cylinder. Now, by the arrangement described the pressure on the top edge of the sleeve will force the same downward for the outer end to engage the cylinder, so that the fluid cannot escape from the pressure chamber to either face of the piston. The sleeve is also pressed on the top edge by springs secured to the pressure chamber, as plainly indicated in the drawings. This arrangement will be found very useful on steam engines of high and low pressure and for heavy trunk pistons of air compressors driven by gas engines. It can also be used on locomotives, as they have a constant pressure of air which may be utilized to float the piston without waste. A patent for this invention has been granted to John C. Junkin, of Grafton, N. D.

A NON-FREEZING VALVE.

The improved discharge valve for tanks which we illustrate herewith is so arranged as to prevent freezing of the parts in cold weather. The invention, which is to be accredited to Mr. P. J. Leithauser, of Clarendon, Texas, provides for the draining of water from the valve and the free circulation of air to absorb all moisture collected on the parts. The valve operates in a pipe which extends through the tank, the lower end being threaded into a short pipe section which contains the valve seat and also the ports for the outlet of the water when the valve plug is lifted. This pipe section connects at the bottom with a discharge pipe. The valve plug is secured to a hollow stem open at the bottom and passing up centrally through the main pipe. Within the hollow stem is a valve rod which is provided with a secondary valve arranged to close the bottom of the hollow stem when the main valve is lifted. This rod at the top is connected by a link with the valve-operating lever, and the latter is also connected by a yoke with the main valve stem, as shown in our enlarged detailed view. The cross arm of the yoke, however, is permitted a small amount of play in the top of the valve stem, so that on operating the lever the secondary valve is first raised to close the bottom of the stem and then the main valve is lifted. On releasing the lever, after the main valve is seated, the secondary valve opens. Just above the main valve plug the valve stem is perforated, and through these openings any water collected in the upper pipe may flow out by way of the secondary valve into the discharge pipe. These perforations also permit free circulation of the air and prevent accumulation of moisture, which on freezing would render the valve inoperative.

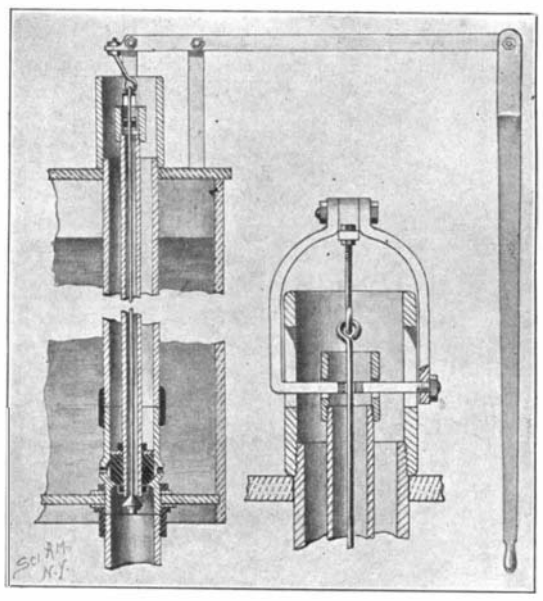


Model of an Airship.

SOME INTERESTING MODELS.

BY H. D. JONES.

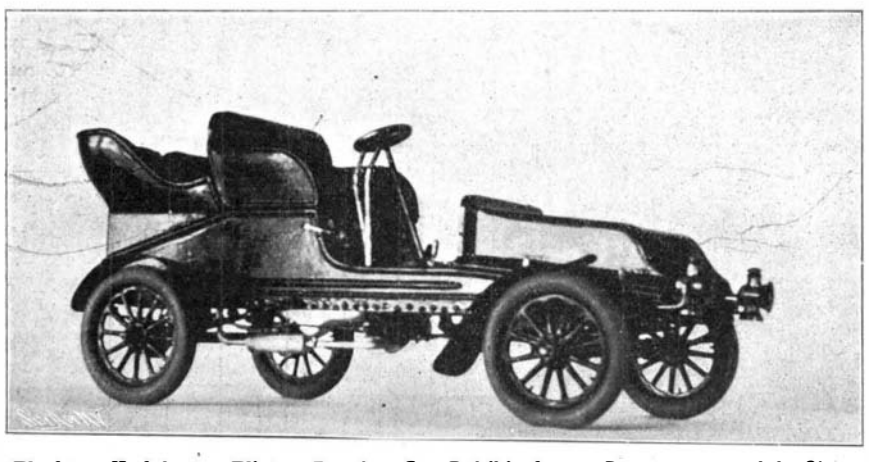
Model making is the hobby of Dr. Frank H. Brandow, president of the Berkshire Automobile Club, of Pittsfield, Mass. We reproduce in the accompanying illustrations a number of exquisitely made models turned out by Dr. Brandow in his private workshop.



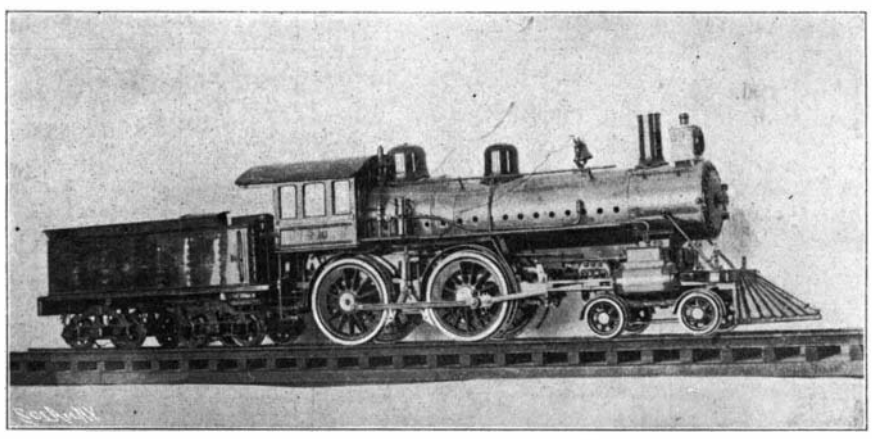
A NON FREEZING VALVE FOR TANKS.

These models were made during leisure hours, and show mechanical skill and ingenuity of a high order.

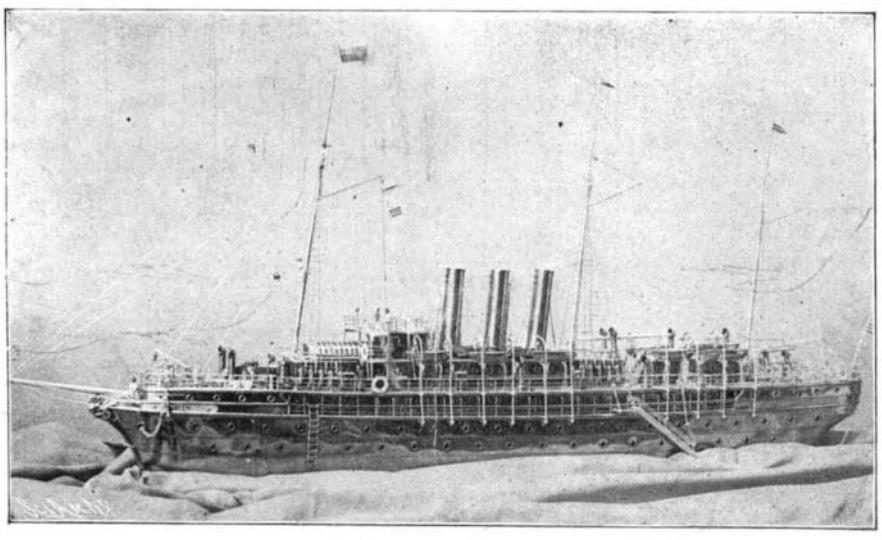
The model of the locomotive "999" weighs about 65 pounds. It is a perfect working model. It differs from the full-sized engine only in being fitted with a brake that works by steam instead of air pressure. Steam for the brake is supplied from a tank just above the forward truck, the tank generally used for air pressure in the Westinghouse brake system. The engine is built of brass, bronze, silver, copper, nickel plate, cast iron, aluminium, and gold plate. There is no woodwork in its construction. The tank is built of burnished copper riveted in the usual way. The headlight is supplied with a two-candle-power electric light, connected with a battery kept under the coal in the tender. The holes drilled in the boiler at the side and the bottom are used for draft for the alcohol burners used to make steam, it being impossible to generate steam in so small a boiler with flues on account of lack of draft. The crown sheet runs the entire length of the boiler, giving large heating surface for steam. The boiler runs on a pressure of from 40 to 60 pounds. Dr. Brandow was a year and a half in making this model. There are several thousand pieces, counting all the small parts. The hand brake in the tender and all the



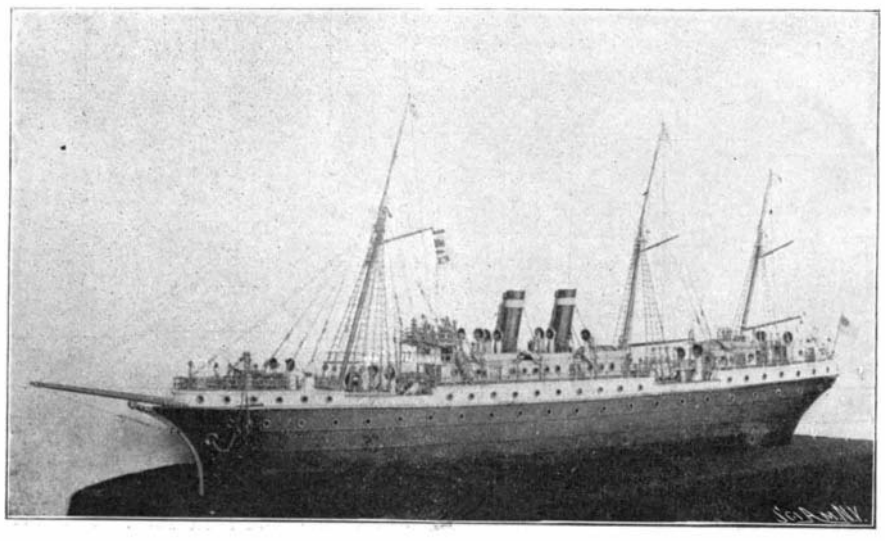
Working Model of a Winton Touring Car Exhibited at a Recent Automobile Show.



A Working Model of Engine 999. Weight 65 Pounds.



Model Constructed of Brass, Iron, Silver and Gold.



Model of an Ocean Liner.

AMATEUR MODEL MAKING.

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piping, for steam, water, and air, with the small valves used in their construction, are perfect copies of the large machine. A metallic engineer stands at the throttle. All the parts are beautifully polished and buffed.

The "Mascot" is a model built on the lines of one of the American Line ships. It resembles the "City of Berlin," but is not an exact copy. The crew of the ship were imported from Dresden, Germany. Every line is a faithful reproduction in miniature of an ocean-going ship. Ten lifeboats hang from the davits, each with a block and fall ready for immediate launching. The bridge is connected with the engine room by electric telegraph, the captain and the two mates being posted in their places as though directing the course of the craft. In the chart room, under the bridge, stands the quartermaster holding the spokes of the wheel. Real compasses are at the service of both bridge and wheelroom officials. The sidelights are fitted with two-candle-power electric lamps. The engines are all fashioned in perfect form. The hull is built of copper. The doctor was eight months making his model. A previous effort on the same lines, representing the "City of Paris," was sold to Mr. John Hood, of Buffalo, for $1,000.

Dr. Brandow is an enthusiastic chauffeur, and has made several working models of automobiles, some of which were on view at the recent Automobile Show. His latest work is a model of an airship, which is worked by a machine that enables the propeller to run for an hour. The doctor is now at work on a new Winton automobile, which is about half finished.

THE AUTOMOBILE AS A PLOW HORSE.

BY W. FRANK M'CLURE.

An interesting experiment was recently tried on the Raser estate at Ashtabula, Ohio, where sparks from a passing train on the Nickel Plate Railroad had set fire to the grass in the adjoining meadows. To cope with the fire plowing was necessary, and the horses not being available at that hour, the owner's automobile was pressed into service. Ropes from the ends of the singletree were attached to the rear axle of the machine. Mr. Raser held the plow-handles, and his brother operated the automobile. Furrows were turned as shown in the picture; but it was found to be impossible to operate the machine slowly enough to get the best results. In order to do this, it would be necessary to gear down the machine to a slower rate of speed. The tendency of the plow was to skim the ground in places, and it was with difficulty that the man at the plow handles could keep up. The automobile, however, served the place of a plow horse sufficiently well for the purpose of breaking up the surface of the ground, and the work was done more rapidly than it could have been in any other way.

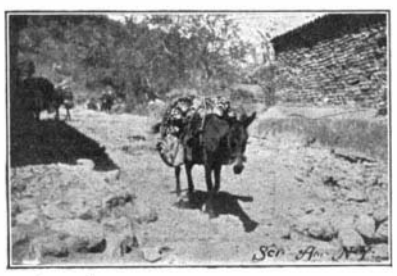
The first test led to another in a few days, when an acre and a half of grass was to be mowed. Here too it was found impossible to operate the machine as slowly as was desirable. However, it was proved that a piece of grass which would require three hours with horses could be mowed in one hour with an automobile as the motive power. On account of this saving of time, the owners will continue to use the automobile for mowing purposes. The machine, which is of the gasoline type, weighs 1,800 pounds, and has a seating capacity for four persons.

The experiment created considerable interest wherever it became known, and raised the question as to whether or not an ordinary automobile can be successfully used for agricultural purposes. There would not seem at first thought to be any inherent difficulties to prevent such use under favorable conditions. The great bearing surface of the tires, the high frictional coefficient of rubber on fairly dry soil or grass, coupled with the weight of the average machine, should render it equal to ordinary plowing or mowing.

Collecting Pulque.

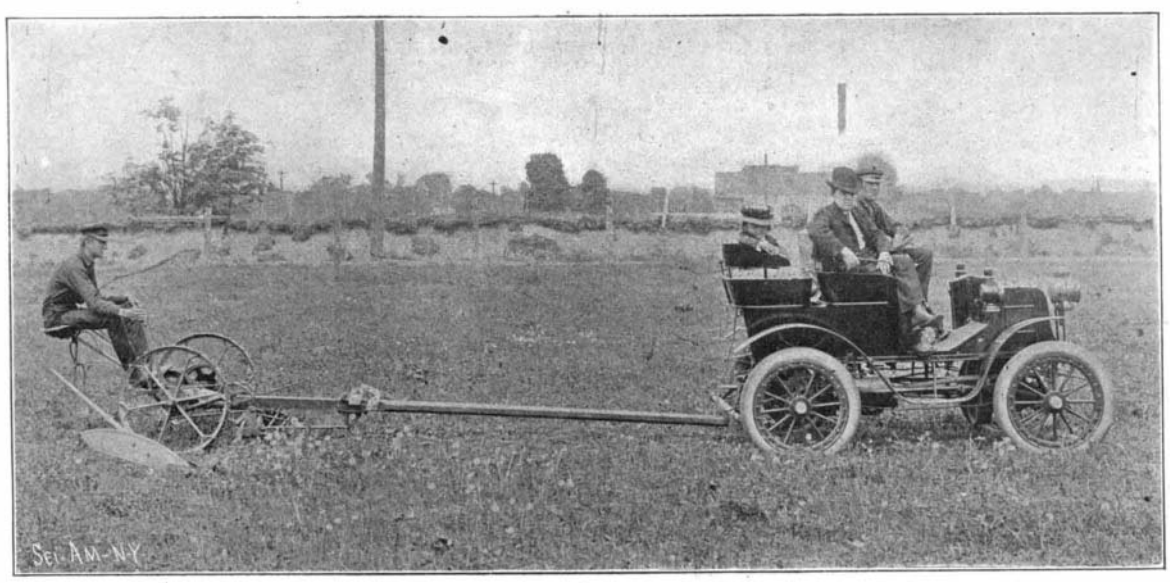
Roasting Agave Hearts Over Baking Pit.

Filling the Fermenting Vats.

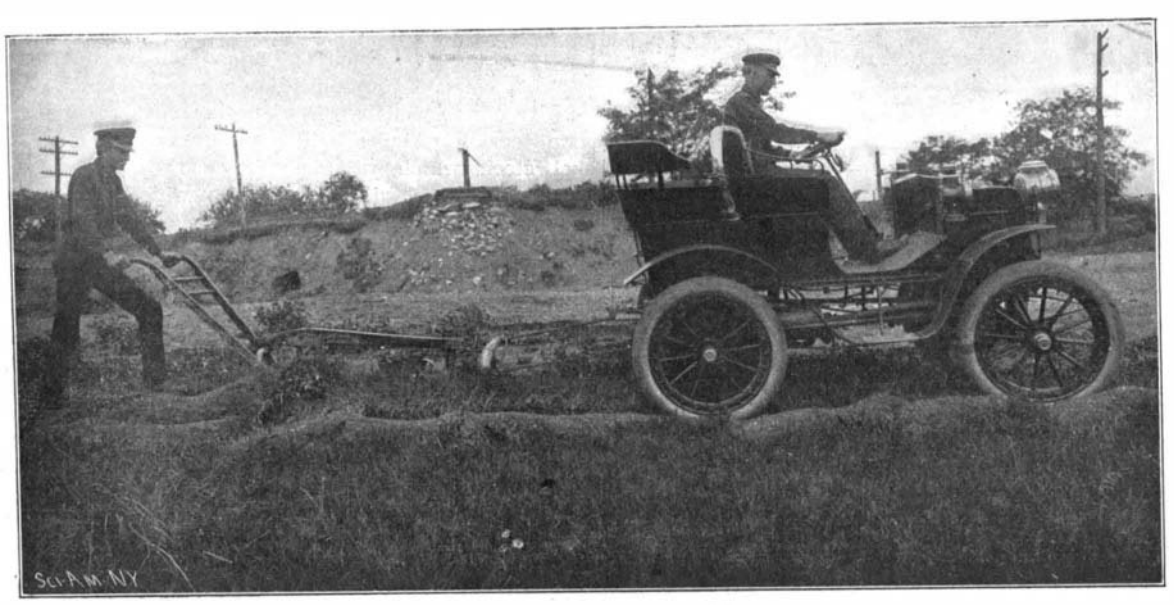


Transporting Agave Heads to the Distillery.

THE PULQUE AND MESCAL OF MEXICO.



THE AUTOMOBILE AS A PLOW HORSE.



PLOWING WITH AN AUTOMOBILE.

THE PULQUE AND MESCAL OF MEXICO.

BY CHARLES RICHARD DODGE.

The American tourist journeying by rail over the plains of Apam, on his way to the city of Mexico, will be surprised to observe the vast plantations of the *maguay* which stretch away on either side as far as the eye can reach. For fifty to one hundred miles, on the different railways, will be seen little else than these Agaves, in all stages of growth from the young plants newly set out—a couple of yards or more apart—to those of mammoth size which are seven or eight years old.

These immense plantations supply the Mexicans of the capital—and of other cities as well—with the drink known as *pulque* (pronounced *pull-key*) which is a national beverage. There are upward of a thousand shops in the city of Mexico where pulque is sold, and hardly a railway station within a hundred miles of the city where the traveler will not be importuned to buy from the boys and women who bring it to the trains in pitchers and jugs of red pottery, dispensing it at a penny or two for a cupful.

On the Mexican Railway, one of the systems connecting the capital with Vera Cruz, a special train is run over the line every morning, laden only with pulque, in barrels and skins, suggesting the milk trains of this country; and it is said that the daily shipments by this train amount to over one thousand dollars. So extensive is the industry that the maguay plantations of the three states of Hidalgo, Tlaxcala, and Puebla are valued at nearly $15,000,000, while the railways have carried over 80,000 tons of pulque in a single year.

Many species of the genus *Agave* produce pulque, these belonging to the *Americana* group of *Agaves*, though two species, *potatorum* and *salmiana*, are the most important, as I was informed by a Mexican botanical authority. The century plant, of our greenhouses, is a *maguay*, and one has only to imagine a century plant, with massive leaves five or six feet in length, to know how these pulque maguays look. They grow to perfection on the high plateau of central Mexico, where the elevation averages about 7,000 feet above the sea level.

When one of these plants reaches maturity its tendency is to flower—throwing up an immense mast or stalk sometimes 25 feet high, upon the branches of which, at the top, the blossoms appear. The pulque operator is always on the alert for indi-

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cations of a blossom bud, and when this appears, he knows the proper time has come to prepare to secure the juices of the plant. To "castrate" the plant, as the operation is termed, a long incision is made in the heart, or central thickened portion, and the tender leaves of the unopened leaf-cluster cut away. The opening thus produced is scraped and deepened until a cavity is made, into which the juices of the fully grown expanded leaves slowly filter. This sweetish, slightly acid liquor is known as *aguamiel* (honey water), and in its fresh state might suggest the odor of root beer. It is removed morning and evening, and can be collected from a plant for a month or more, about four quarts being the average daily product. This goes on until the plant is exhausted and the leaves withered.

The liquor is collected by means of a long narrow-necked gourd, hollow of course, and with a small hole at each end. Placing one end in the filled cavity of the plant, and the other to his lips, the collector withdraws the air by inhalation, the pulque filling its place. Then, closing the upper hole with his finger, the gourd and contents are carried to a waiting mule nearby, and the liquor transferred to goatskins or other receptacles secured to the saddle. In this way he goes from plant to plant where the juices are exuding. The larger illustration gives a good idea of the operation. I am indebted to Cox and Carmichael, photographers of Mexico City, for this illustration.

At the depot, or warehouse, the pulque is transferred to the reservoirs, which are often lined with oxhides, and a little sour pulque added to induce fermentation, the fermented liquor becoming cloudy, as though mingled with milk.

Having a wholesome fear of microbes, I did not feel equal to testing the virtues of pulque in any stage. The well-worn gourd with its mouth-hole, and the dark, greasy-looking goatskins, to say nothing of the general appearance of the peons in charge of operations, I think would deter a man with even a stout stomach. It has been stated that the distinguishing characteristic of pulque is the odor of decaying meat, and that in order to lessen this unpleasant smell, orange and lemon peel are thrown into the receptacles while the fermentation is proceeding. Nevertheless, the beverage is universally used, and is considered healthful when taken in moderation, especially in regard to its action on the kidneys. But many pulque drinkers in Mexico do not use it in moderation, and in a certain stage of fermentation it is quite intoxicating.

The earliest use of pulque is said to date back to the latter half of the eleventh century, and to the reign of the eighth Toltec chief, Tepzucoltzin.

Quite a different liquor is *mescal*, although it is the product of a similar plant, but with narrower leaves, for the group of plants called mescals are also *Agaves*. Some writers have stated that the mescal is distilled from pulque, but it is a mistake. The mescal distilleries are found in every portion of Mexico, but the best liquor comes from Tequila, in the state of Jalisco, west of Guadalajara, and is known as Tequila wine—or simply as "Tequila." It is a fearful intoxicant, although, aside from its fiery quality, its taste is not bad, faintly resembling Scotch whisky. The distilleries are for the most part primitive affairs, and, at Tequila especially, are interesting.

Tequila is a place of some 6,000 souls, located twenty miles from the railroad, and for miles in every direction around the city there are plantations of a particular form of *Agave* which sends forth its narrow leaves from a great bulb-like, cellular mass which forms the heart of the plant. This heart, when denuded of its stiff, sword-like leaves, and detached from the root, is cleft in two, and a dozen of these pieces make a fair load for a mule. Trains of mules or burros may be seen all day in the streets of Tequila transporting the Agave heads from the country to the distilleries. One of the small illustrations shows this process.

The first operation that the raw product goes through is the baking or roasting. This is done in pits dug within the distillery inclosure. These are four or five feet deep, and considerably wider. A hot fire is built of mesquite wood, large stones being distributed through the fuel. The cleft heads of the mescal plants are then heaped over the burning mass until a huge mound is formed. This is covered with grass, and finally with earth, and the mass left for several days to cook. When the mound is opened the raw product is found to have changed to a dull brown in color, and the juices to have been converted into sugar. While hot and steaming the material is taken to another pit, stone-paved, on the bottom of which revolves a big stone crusher, driven from a sweep by mule power. Here it is ground into pulp, and the semi-liquid mass transferred in deep trays, borne upon the heads of Indians, to the vats, where it remains until fermented. Then it goes to the still, and finally is run off as mescal.

The finished product is a colorless liquor, sometimes with a slight amber tint, though much of it is like alcohol. Some of the higher grades bear fancy names, such as "Crema-Sauza"—meaning the cream of production of the establishment controlled by the Sauza family—and such names become trade marks designating quality.

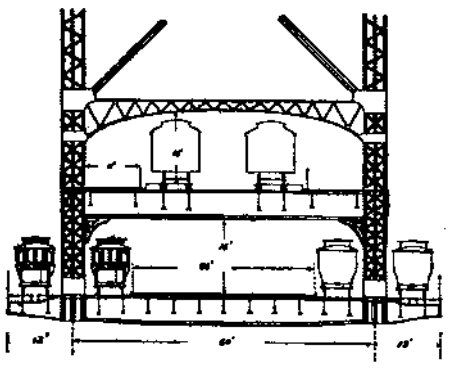
Another Mexican liquor, called *Zotol*, is produced in the more northerly portions of the country. It is likewise produced from the bulbous part of an *Agave*, a small species with extremely narrow leaves, like the true *Dasylirion*. I have not seen this spirit, but was told it is so strong that 95 per cent alcohol is mild in comparison.

Still another fiery liquor is distilled from sugar cane, and is called *aguardiente* (burning water). Why these strong liquors should be so popular with the Mexicans is surprising, but it should be remembered that these people are also fond of such hot substances as "chile" and "tabasco."

BLACKWELL'S ISLAND BRIDGE.

After a checkered career extending over a period of twenty years, the scheme for the construction of the greatly-needed bridge across the East River at Blackwell's Island has at last taken definite and final shape in the issuance of the plans and specifications for the superstructure from the office of the Commissioner of Bridges.

The first franchise for the bridging of the river in this vicinity was granted to a private individual as far back as 1884, but it was not until the latter part of the year 1898 that plans were drawn up by the Commissioner of Bridges and received the approval of the Board. The site selected has its Manhattan terminus on the block bounded by Fifty-ninth and Sixtieth Streets and Avenues A and B, and the original plan contemplated the erection of a cantilever bridge of five spans, carried on four piers, one pier on each shore of the river, and two intermediate piers on Blackwell's Island. Work was commenced on the piers in the latter part of September, 1901, and was carried forward so slowly that on the first of January, 1902, the value of the completed work was only about $42,000. The original plans were revised by the present Bridge Commissioner, the changes affecting chiefly the superstructure, the alterations in the piers themselves being of minor importance and largely of an architectural character. The revised plans call for two cantilever bridges consisting of the following spans: A shore span on the Manhattan side, 469 feet 6 inches in length; a river span of 1182 feet; a center span across the Island, 630 feet in length, followed by a river span 984 feet long over the easterly channel, and a shore span on Long Island, 459 feet in length. The changes in the piers include a system of elevators and stairways designed to afford access to the bridge from Blackwell's Island.



CROSS SECTION, BLACKWELL'S ISLAND BRIDGE.

On upper deck, two elevated railroad tracks and two 11-foot pathways. On lower deck, two overhead and two underground trolley tracks and a 36-foot roadway.

We present on the front page of this issue a perspective view of the bridge taken from a point on Manhattan Island which affords an excellent idea of the architectural and engineering features of the structure as they will appear when the structure is completed. The bridge will be made up of two lines of trusses, spaced 60 feet from center to center. The top chord, which is the main tension member, will consist of eyebars of nickel steel, which will be made 12 inches to 18 inches in depth and will vary in number according to the stresses that have to be provided for. The bottom chord will be of standard box construction, of the kind that is universally in use in long-span bridges in this country. The floor system will be carried on very heavy transverse floor beams, which will extend beyond the trusses for a sufficient distance to accommodate two lines of underground trolley cars. Between the floor beams will be worked in the usual plate steel stringers, and the whole floor will be covered with buckled plates. It is needless to say that the two great channel spans will take rank among the longest trussed spans in the world. In the United States, the longest bridge of the trussed type is the Wabash Bridge at Pittsburg, which has a clear span of 812 feet. The bridge will be double-decked throughout. On the upper floor provision will be made for two elevated railway tracks, with two foot-walks, each 11 feet wide, carried on the outside of the elevated tracks and between them and the cantilever trusses. On the lower floor, adjoining the trusses, will be two tracks for overhead trolley cars, and on the outside of the trusses will be two tracks for the underground trolley cars. Between the overhead trolley tracks will be a splendid roadway for vehicles, with a clear width of 36 feet.

The towers will consist each of two massive legs of box-section, which will be spaced 93 feet from center to center transversely at the base and 60 feet from center to center at the top of the towers. The height measured from center to center of the chords at the towers will be 185 feet. The two legs of the tower will be heavily sway-braced, and at the top they will be connected by deep lattice trusses and by a blunt arch designed to harmonize architecturally with the general treatment of the whole bridge. Above the towers will extend lofty, ornamental finials of open ironwork.

The tests required of the nickel-steel eyebars call for an ultimate strength, unannealed, of 90,000 pounds to the square inch, an elastic limit of 54,000 pounds to the square inch, and an elongation of 18 per cent in 8 inches, with 35 per cent reduction of area. The annealed specimens must show 85,000 pounds ultimate strength, 50,000 pounds elastic limit, 20 per cent elongation in 8 inches and 40 per cent reduction of area. An annealed test piece of 4 inches width or more must be capable of being bent cold 180 degrees around a pin, whose diameter is twice the thickness of the test piece, while the unannealed specimen must bend 180 degrees around a pin whose diameter is three times the thickness of the test piece.

In addition to its own dead load the bridge is designed to carry live loads of 6,300 pounds per linear foot of bridge, as ordinary traffic, and 12,600 pounds as congested traffic, while unusually heavy, concentrated loads are assumed for the floor system. The foot-walks are to be constructed to carry a maximum load of 100 pounds on every square foot. The under side of the floor of the bridge will have a clear height above mean high water of 118 feet, and the maximum grade will be 3.4 per cent on both the New York and Brooklyn approaches. The total length of the bridge, including the approaches, will be 7,636 feet, and the total estimated cost, including the purchase price of the necessary land, is $12,548,500. It is expected to have the bridge completed by the first of January, 1906.

Aftermath of the International Wireless Congress.

The United States, Germany, Austria, Spain, France, and Russia have signed the protocol adopted at the recent International Congress for Wireless Telegraphy held in Berlin. Great Britain and Italy have so far withheld their signatures. The protocol provides for the construction of coast stations to allow communication with ships at sea regardless of the particular system of wireless telegraphy which a vessel may happen to use. To facilitate the transmission of messages the protocol also provides for the technical explanations of all systems. A general system of charges is to be introduced. Services are to be so regulated that signal stations will disturb one another as little as possible.

Great Britain thought no system should be used unless a certainty of connection was guaranteed. Italy supported Great Britain, declaring that it could not repudiate its agreement with Marconi.

Fossil Pollen Grains.

M. B. Renault contributes an article on the occurrence of fossil pollen grains. These may be preserved either in organic media, lignite, bog-head or pit-coal, or in such mineral substances as calcium carbonate and silica. They are found in primary beds, and are generally dispersed or may be located in the pollen sacs or in the interior of pollen chambers. The structure is so well preserved that projections representing the pollen tubes are evident, and in some cases the division of the grain into cells, e. g., the prothallus, may be clearly distinguished. In the case of *Stephanospermum*, which is assigned to the gymnosperms, there is evidence of quite a definite pollen tube, and similar appearances are noted for the genus *Aetheotesta*. In some cases the pollen grain is devoid of the outer layer, the exine, which Renault believes has been shed that the pollen grain may pass through the entrance into the pollen chamber. In the case of *Dolerophyllum*, a genus placed in the Cordaiteæ, part of the wall becomes detached like an operculum to allow the prothallus to grow out or possibly to allow the antherozoids only to escape, and find their way to the archegonium.—Comp. Rend.

It is reported that a hot spring has been struck in the workings of the Simplon Tunnel, and the increased heat is unbearable. About two miles remains to be bored.

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Electrical Notes.

Henri Moissan has succeeded in reducing tantalum acid in the electric furnace with powdered carbon and has obtained tantalum in a fused state. Hitherto the metal had been known only as a more or less pure powder with a density of 10.50. The electrical product has a brilliant metallic appearance, and a density of 12.79. It is very hard, easily scratching glass and quartz, has a crystalline fracture, and is infusible in the oxyhydrogen blowpipe. Certain reactions class it with the metalloids rather than with the metals proper.

The system of posting and collecting letters by electric trams which has been successfully tried in some of the northern towns of Great Britain, is being adopted on the electric tramway system at Sydney, in New South Wales, but on a more extensive scale. The scheme includes the erection of a small clearance office at one of the important termini, and letters as they are cleared will be sent off by messengers to the general post office every 15 minutes. In this way, it is believed, communication between the suburbs and the city will be greatly expedited, and this has certainly been the experience of those places which have adopted the system in this country. It is also proposed to arrange for boxes to be put on cars running to the railway station, so that letters too late for the general mail at the post office may be posted on any car reaching the station before the departure of the mail train. There is some difference of opinion at present as to the rates to be paid by the post office for these privileges, but it is hoped that a fair agreement may be come to which will allow the scheme to be put into operation.

In a paper published in a recent issue of Glaser's Annalen, M. E. Cserháti makes an interesting comparison as to the relative advantages of steam and electric locomotives for main line traffic, using as basis figures noted on the Valtellina line. On this line it has been found that on the average each ton moved a kilometer requires 33.5 watt-hours, as measured at the central station switchboard. The daily output averages 9,600 kilowatt-hours, the cost per unit being 1.94 centessimi (.352c.), and 1,000 ton kilometers cost therefore 65 centessimi (11.8c.). With steam traction on the same line the cost for coal was 235.6 centessimi (43c.). An increase in the traffic density would still further improve the showing of the electrical plant. For equal tractive power the electric locomotive is much lighter than a steam locomotive, even when the tender, weighing from 20 to 50 tons, is not taken into account. It appears further that, for some reason or another, the coefficient of adhesion is markedly greater with the electric locomotive, ranging from 25 to 30 per cent of the weight on the axles, while with steam engines it generally runs at about 16 per cent. This feature of the electric locomotive is particularly favorable in the case of mountain lines. The internal friction is also much less. Thus, in the case of a steam engine running at 40 miles per hour, the resistance is about three times as great as that of wagons carrying an equal load; while with the electric engine it is only 20 per cent more than in the case of ordinary wagons.

In a report presented to the International Congress at Düsseldorf, L. Gérard gives his experience with electric traction on the Charleroi-Brussels canal. He finds that the ordinary towpath is quite unserviceable, the coefficient of traction being 4 or 5 kilogrammes per ton. The number of units taken per barge-kilometer varied with the time of year, i. e., with the condition of the towpath, between 3.04 in March and 2.24 in October, 1901. The efficiency of the tractors after a year's service is about 0.48. Unloaded and traveling at 4 kilometers per hour, the tractor takes 4.1 kilowatts; when hauling a barge of 70 tons at the same rate, the power required is 4.85 kilowatts. The wear and tear on the wheels of the tractors, which are of cast Martin steel, is very serious; and the author considers that repairs of all kinds cost three times as much as they do on an ordinary tram line of the same length. It had been supposed that either heavy tractors would be necessary to secure adhesion or that a rack rail would be necessary. Experiments were undertaken on the canal with a view to finding the pull at starting. With a heavy tractor running on the towpath, and a pull falling from 625 kilogrammes to 120 kilogrammes, a speed of about 3.5 kilometers per hour is reached in 50 seconds, with a barge of 70 tons; with a tractor weighing 1,650 kilogrammes, and giving a steady pull of 264 kilogrammes, the same speed would be reached in about 30 seconds. Some experiments which were carried out at Oisquercq under rather unfavorable conditions showed that full speed could be reached in about 45 seconds with a light tractor on rails; and this tends to confirm the result of theoretical calculations. Gérard therefore advises that rails should be laid on the towpath, and the experiments continued.

Engineering Notes.

On June 30 last there were 57 warships of 319,700 tons displacement in course of construction in England. Of this number 12 vessels were being built in royal dockyards and 45 in private yards.

According to the latest account the great Simplon tunnel of the Alps is about three-quarters completed, and when finished will be 14 miles long, or twice the size of the Mont Cenis bore. It is expected that the Simplon tunnel will be ready for use in about two years. One of the greatest obstacles encountered in the work is the high temperature in the center of the bore, which compels the employment of two gangs of men on short shifts. Power for compressing air for the drills and refrigerating the tunnel is furnished by a flow of water from the south end of the bore at the rate of 15,000 gallons per minute. It is estimated that the cost of the tunnel alone will be about $1,000,000 per mile, or nearly the same as the contract for the subway under New York city.—Engineering and Mining Journal.

In a paper read before the Aberdeen Mechanical Society, a few suggestions were made on the subject of belt-dressing. Leather belting can be made to transmit the maximum of power when careful attention is paid to its condition. The driving face of the belt should be kept in a clammy or mastic state by applying a good coating of a trustworthy belt dressing at intervals of about eight weeks. The dressing should be made up of fish oils and animal fat to a consistency of soft ointment, spread over both sides of the belt with a square brush like a shoe brush. A belt attended to in this way will run much slacker than a dry belt, and the pulling side will hug and suck to the pulleys, while lifting the load without slip. There will be no loss of power from overstrained bearings; a dressing of this sort keeps the leather fresh and prevents the atmosphere from penetrating into and drying the natural sap out of the leather, while preserving its life for many years. Mineral or vegetable oils should never be used. Castor oil dressing soon causes leather to perish and rot. Boiled linseed oil makes a capital dressing for cotton belting; it soon oxidizes and gives the cotton belt an elastic gummy driving face.

The most reliable method to determine the steam consumption of an engine is to make an evaporation test; that is, to measure the water fed to the boiler in a given time and delivered to the engine in the form of steam. This method, however, entails considerable trouble and expense. So engineers often figure out the water consumption from indicator diagrams. The terms water consumption and steam consumption are here used indiscriminately, for a pound of water will produce a pound of steam at any pressure. Figuring that way can never be wholly accurate, because the data requisite to insure results are not thus procurable. That is, the amount of water accounted for by the indicator is always considerably less than it ought to be because of cylinder condensation, valve and piston leakage, to the extent that it might be that only 50 per cent, or at best not more than 90 per cent, of the water passing through the cylinder would be accounted for by the indicator. But if the cylinder were properly steam jacketed, or if superheated steam were used, and there were no leakage of steam from valves or pistons, the water consumption could be closely calculated from an indicator diagram.—Mining and Scientific Press.

A German invention recently announced comprises a system for obtaining motive power economically by the use of working fluids having widely different boiling points, which are employed in the motor cylinders at temperatures above the critical temperature. From a general description, it seems that the invention embodies a combined steam and gas engine and a liquefied carbonic acid apparatus. In this combustible gas drawn from the producer or generator, or from any other suitable source, is forced into the motor cylinder along with oxygen, or air rich in oxygen, drawn from a holder, and is there ignited. At the same time superheated water is injected from a heater, and is converted into steam, the quantity of heat supplied being such as to keep the temperature above the critical point. The exhaust from this cylinder is then circulated round the carbonic acid cylinder, and through a coil tube generator, in which the liquid carbonic acid is gasified, and a portion is then finally delivered into the gas producer, to be reduced, and the remainder is discharged into the chimney. The exhaust from the carbonic acid engine is again liquefied to be used again in a coiled tube condenser, cooled by an ammonia compression apparatus, consisting of a compressor and water-jacketed condensing coil. When liquid oxygen is employed, its pressure may first be utilized in another working cylinder before it is passed into the gas producer or generator. Among the liquids of low boiling point that may be utilized are alcohol, benzol, ether, acetone, and sulphurous acid.

German Toy Industry.

The toy industry of the Erzgebirge, or Ore Mountains, which has been developing for centuries, has been slowly drifting into economic difficulties. With the application of steam power and modern machinery to the production of toys the house industry has been gradually forced to the wall. With an increase in the price of wood and a decrease in the price of the finished product these people of the mountains have been put into a position where it is necessary to toil night and day for a meager existence, which is apparently becoming more and more severe.

For some years the labor press of this part of the country has busied itself with a portrayal of the wretched conditions existing among the peasants of the mountains, with the result that an investigation was recently made by the industrial commission of Freiburg which largely substantiates even the strong representations of the labor organs. The main point of the report of this commission may be summarized as follows:

The number of large establishments engaged in the manufacture of toys is increasing. This might be considered *prima facie* as a welcome sign were it not for the fact that the toys are not manufactured upon the regular factory plan with hired hands, but are made by men who have rented space and machines quite independently of one another, and who form a sort of voluntary association banded together only for the sake of economy in roof and equipment, but carrying on their own separate businesses. A disinclination is said to prevail among the young men to enter a factory on the basis of wage-earners and be subjected to the immediate control, supervision, and direction of an employer. Rather than earn the higher income afforded by the factory wage the young men in the hills prefer a much more meager existence in the independence and freedom of their own homes. Because of the fact that the inhabitants of the mountains make but few and simple demands upon life, the real wretchedness of their situation is said to be but rarely fully appreciated.

The wage conditions existing in the toy industry can be readily observed from the following figures prepared by the commission referred to: The most remunerative branch of the trade affords a gross income of from 24 to 40 marks ($5.71 to $9.52) per week, one-half of which may be considered as profit. In other branches the net income is as low as 6 to 9 marks ($1.42 to $2.14) per week. It must be remembered that these incomes are not the earnings of a single person, but represent the labor of entire families.

How inconceivably small the price paid for certain kinds of toys is can be seen in the case of pencil boxes of the cheapest quality, for which the maker gets from 48 to 58 cents per gross.

The daily meals of these people are reported by the commission to be confined largely to potatoes, linseed oil, bread, and coffee, and, at times, meat on Sundays.

With the price of wood rising, toy factories increasing in numbers in other parts of the country, and the price of toys falling, it seems that the people of the Erzgebirge must, in their increasing wretchedness, find some other means of sustenance. Exporters of toys who operate large factories in this neighborhood report good business and are of the opinion that the house industry of the Erzgebirge is doomed, and that the peasants will be forced to give up their independent production and enter factories.

Cerium Silicide.

Sterba has obtained cerium silicide, $CeSi_2$, in the form of steel-gray, brittle, microscopic crystals, by heating together in the electric furnace cerium oxide and pure crystalline silicon. Reaction is immediate, and is complete on fusion. The button of crude silicide is freed from adhering silicon by digestion on the water-bath with caustic potash, when $CeSi_2$ is left in a pure crystalline condition. It is insoluble in water, has the specific gravity of 5.67 compared with water at 17 deg. C., and is insoluble in organic solvents. Hydrogen is without action on it at all temperatures. Fluorine combines with it, in the cold, with incandescence; iodine, bromine, and chlorine only when heated. At ordinary temperatures, air and oxygen are without action on it, but when heated to redness the latter combines, and, in a flame, $CeSi_2$ burns with brilliant sparks. Sulphur and selenium combined with it at their boiling points with a slight emission of light. Gaseous HCl attacks it at a red heat. HCl and HF in solution and other mineral acids decompose it, liberating hydrogen. Organic acids only react with it when heated. Alkalies in aqueous solution have no action, but the same in a state of fusion combine, with incandescence. $CeSi_2$ melts in the electric furnace, forming a crystalline, silvery mass when cooled. In general properties it differs from calcium silicide, and resembles the compounds of silicon with the heavy metals. It is quite distinct from the cerium silicide, Ce_2Si, obtained in 1865 by Ulik, by the electrolysis of cerium fluoride and of potassium.—Comptes Rend.

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EXPERIMENTS WITH MOTOR-DRIVEN AEROPLANES

Our illustrations depict experiments with an aeroplane carried out recently by Mr. Gustave Whitehead, of Bridgeport, Conn., who has been studying the subject of mechanical flight for upward of fifteen years. In one of the pictures is shown a light-weight, two-cycle motor, which was used on the aeroplane in a recent experiment.

Unlike Lilienthal and Chanute, Whitehead does not attempt to soar by jumping off a hill or precipice. He is content, on the contrary, with flying near the ground, if he can only solve the problem of rising from it quickly at will, and descending gently whenever and wherever he wishes.

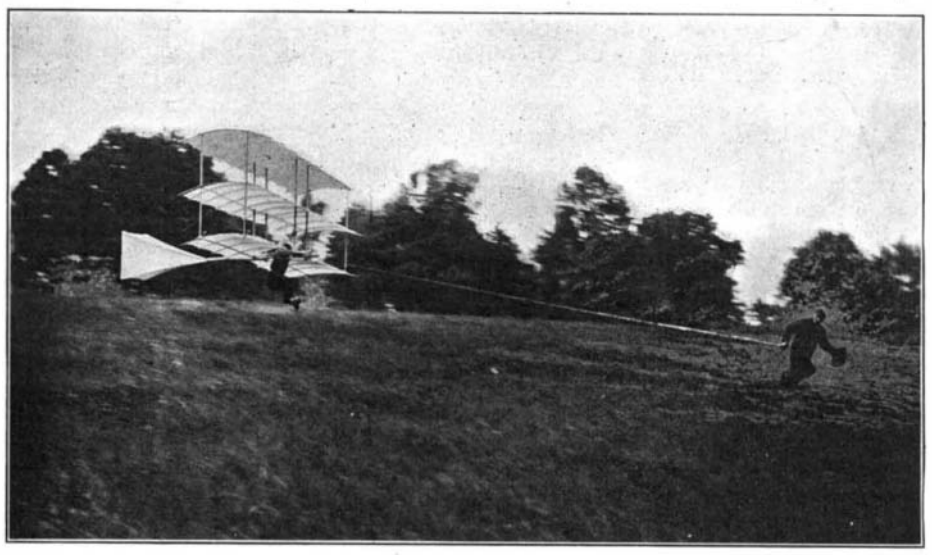
The method of soaring used by Mr. Whitehead consists in running with the aeroplane against the wind, preceded by an assistant who draws it with a rope when it leaves the ground. When sufficient speed is attained, the operator, by tilting the aeroplanes slightly upward, can leave the ground and skim along in the air, as shown in one of the photographs. The trimming of the aeroplanes, both longitudinally and transversely, is accomplished by the operator shifting the position of his body, and the proper trimming necessary to keep from taking a plunge is quite a delicate matter. A puff of wind striking the aeroplanes harder on one side than on the other can also easily upset their transverse stability, unless the operator is quick to counteract it.

After practising considerably at balancing the aeroplanes when drawn by a man, Mr. Whitehead at length designed and built a light-weight, two-cycle gasoline motor for propelling them. This motor is of the air-cooled type, and has numerous loops of aluminium wire fastened to the two cylinders in order to radiate the heat. The inventor says that he has found aluminium to be much better for this purpose than copper, which is the metal generally employed. The cylinders of the motor have a 4-inch bore and a 4½-inch stroke, and it is designed to run at speeds of from 1,000 to 2,500 R. P. M. It develops 12 horse power at the latter speed, and its weight complete is but 54 pounds, or 4½ pounds per horse power, which shows it to be one of the lightest gasoline motors ever built. Over 100 pounds compression is employed, the sole compression space being the small dome on top of each cylinder, in the top of which is seen the sparking plug. The motor, being of the two-cycle type, is valveless, with the exception of light aluminium check valves, through which the gas passes before making its entrance into the sheet-steel crank case (which is divided by a central partition) through the holes seen in its side. Splash lubrication is employed in the crank case, and oil is fed to the cylinders from two oil cups. A 25-inch wire wheel was used as a flywheel, and carried fan blades for assisting in cooling the motor. Its dimensions are 18 inches high by 12 inches long by 8 inches wide, and in the experiments made with it, a two-bladed propeller 4½ feet in diameter was fastened on the motor shaft and revolved at a speed of 1,000 R. P. M. As the motor has four disk flywheels inside its crank case, the large wire-spoked one is not absolutely necessary, and in actual tests, when mounted on the aeroplanes, the motor was found to work equally well without it, thus reducing the total weight of the motor to 47¼ pounds.

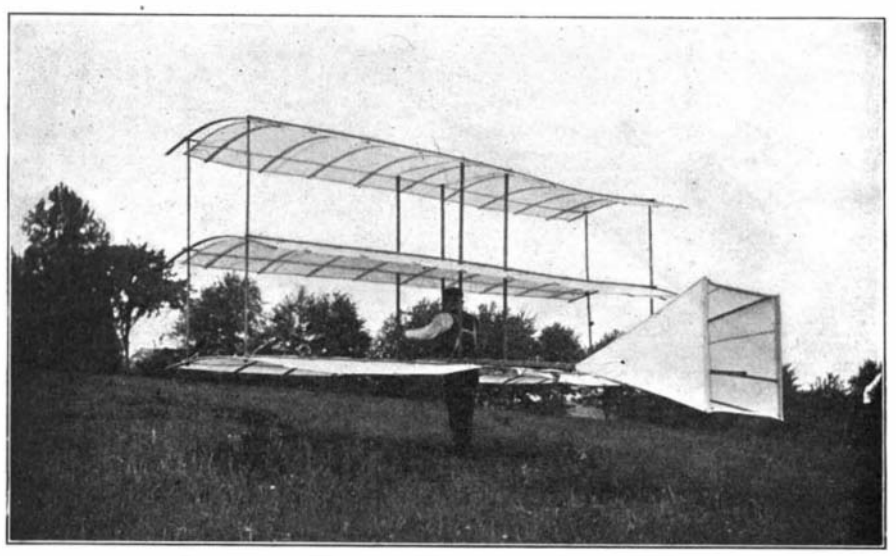
The three aeroplanes are spaced 3 feet apart and are 16 feet long by 5 feet wide. They are made up of spruce wood frames, covered with muslin, and are suitably braced with diagonal wires. There is a space in the center of the lower one for the operator, who hangs from the two forward uprights and keeps the apparatus in trim by shifting his body. A rigid, pyramidal-shaped rudder projects from behind.

After ascertaining, by loading himself with sandbags, that the aeroplanes were capable of lifting the extra weight of the motor and propeller, the motor was attached to the two longitudinal projecting rods of the lower aeroplane, and carried the propeller in front of it on its crank shaft. By running with the machine against the wind, after the motor had been started, the aeroplane was made to skim along above the ground at heights of from 3 to 16 feet for a distance, without the operator touching, of about 350 yards. It was possible to have traveled a much longer distance without touching *terra firma*, but for the operator's desire not to get too far above it. Although the motor was not developing its full power, owing to its speed not exceeding 1,000 R. P. M., it developed sufficient to move the machine against the wind. The total thrust, or, in this case, pull of the propeller was found to be 280 pounds, while all that is needed to keep the machine in the air, according to the dynamometric measurements made when it was drawn by a man, is a pull of 28 pounds. Making the propellers pull, instead of push the machine, aids greatly in maintaining its stability.

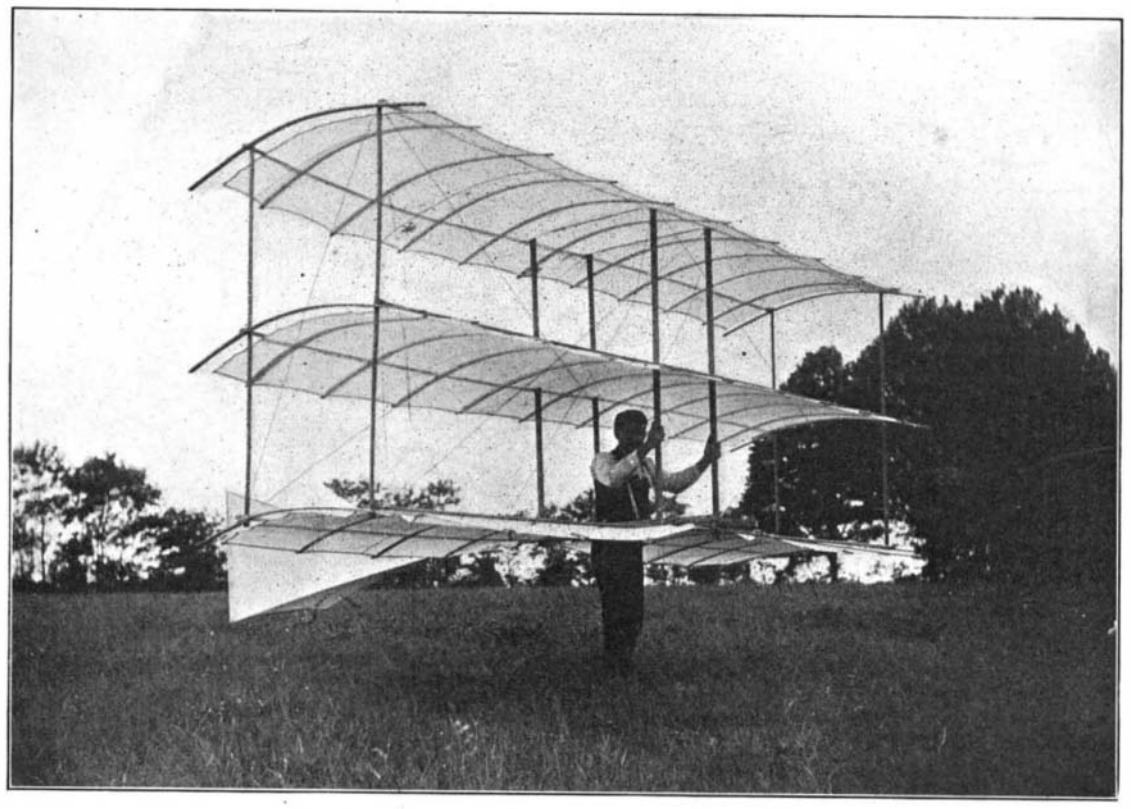
Having proven that a less powerful motor will do the work, Mr. Whitehead is now constructing one of 6 horse power which will weigh between 25 and 30 pounds. He intends to drive two 4½-foot propellers with this, by means of bevel gears, giving the proper speed reduction for obtaining a speed of 600 to 800 R. P. M. of the propellers. Besides this smaller two-cylinder motor, he is also constructing a four-cylinder one, of 10 horse power, which he expects will not exceed 40 pounds in weight, aluminium being used as far as possible in its construction. This is to be used on an improved aeroplane with which the inventor hopes to be able to rise vertically in still air, travel horizontally, and descend vertically again. This is the desideratum of the aeroplane flying machine.



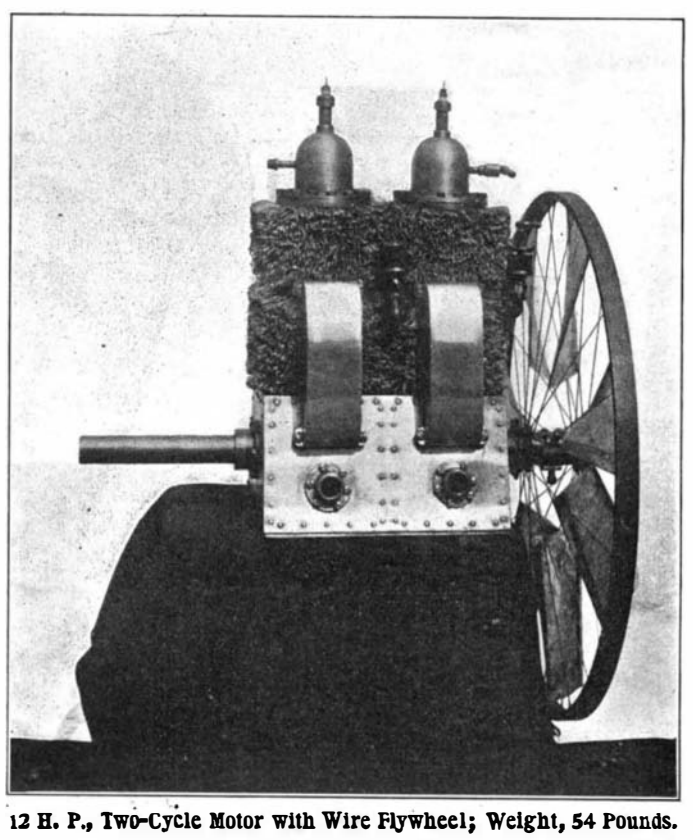
Gliding Near the Ground Against a 15-Mile-an-Hour Wind.



Rear of Aeroplane, Showing Pyramidal Rudder.



Front of Aeroplane, Showing Operator in Position.



12 H. P., Two-Cycle Motor with Wire Flywheel; Weight, 54 Pounds.

EXPERIMENTS WITH THE WHITEHEAD AEROPLANE.

The Current Supplement.

The current SUPPLEMENT, No. 1446, contains the second installment of "The Mechanical Handling and Conveying of Coal and Coke," illustrating the best foreign practice. "The Siemens & Halske Fire Alarms" gives detailed illustrations of the Berlin fire and accident alarms, and other types are shown as well. "Practical Receipts for Silvering" gives a considerable number of valuable formulae. An article on a "Unique Color and Paint Laboratory" is devoted to an up-to-date technical and research laboratory built with special reference to the examination of paints and dyestuffs. "Artificial Silk, a Problem in Chemical Invention," describes this most interesting duplication of nature's work. "The Present State of the Art of Electro-Culture" is by Emile Guarini. The usual Engineering Notes, Electrical Notes, Trade Notes and Recipes, Selected Formulae and Trade Suggestions from United States Consuls will be found in their accustomed places.

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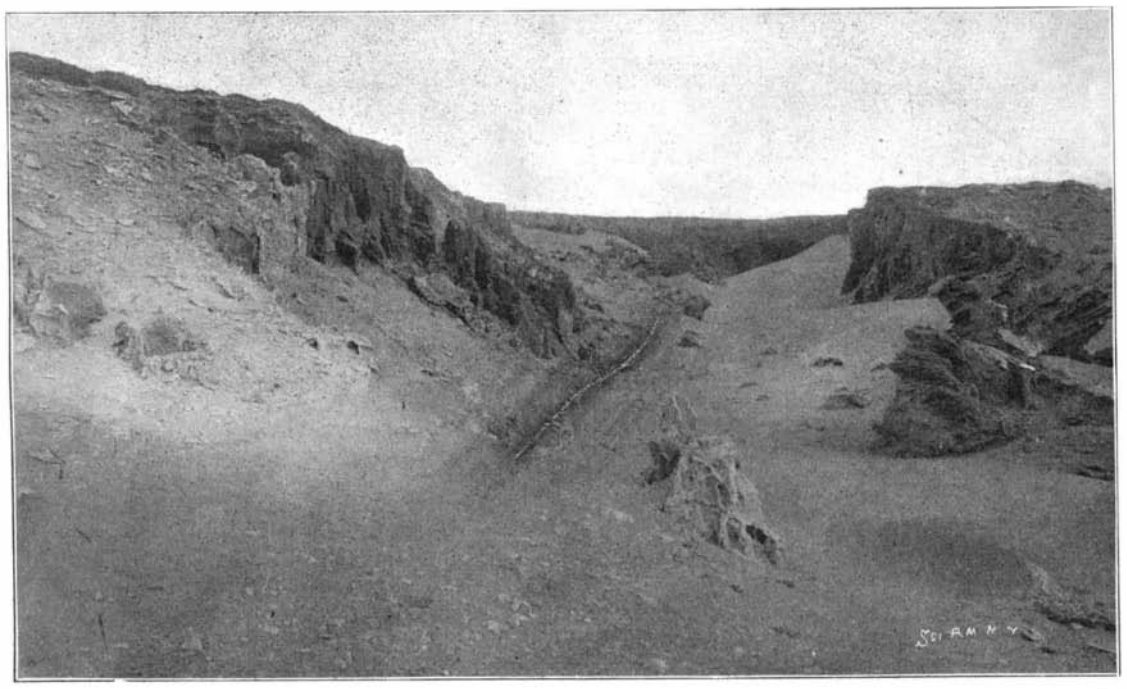
A SINGULAR PROFESSION.

BY PROF. C. F. HOLDER.

Among the more or less singular industries followed in the West is that of systematic grave looting, or as it is politely and euphemistically called, the "excavation of mounds," the object of which is to secure the various articles of stone, wood, and shell which were deposited in the graves of the ancient Californians, it being the practice from the earliest times to bury with the dead all his or her possessions. The custom of grave or mound digging was started about twenty-five years ago, when the government, having heard of large deposits, mounds, and graves on the Pacific coast, organized an expedition in the interests of science, and made a careful and prolific investigation of the entire coast. How much material was secured is not known, but it doubtless amounted to tons, and enriched several institutions of science, giving to the public in this country and England the first really valuable collections telling the story of the past history of the natives of the Pacific coast. Had the action of the National Museum been delayed, the opportunity would have been lost, as a looting epidemic spread over the land soon after, and every ancient burial place along the coast was searched. As a result of these early investigations, there is a good Californian collection in England, one in the National Museum, one in Salem, and one in the American Museum of Natural History, New York, while others have fine collections, made at various times.

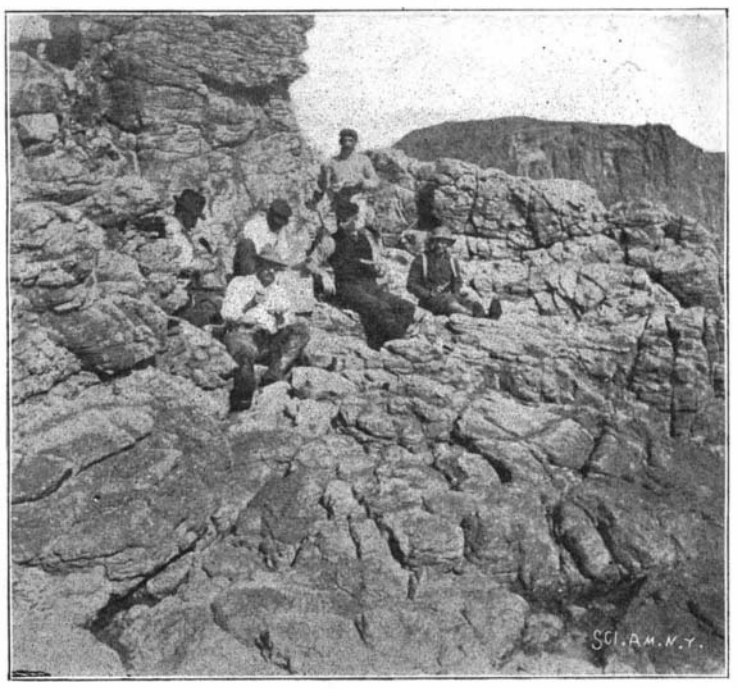
It would be manifestly impossible to take all the material representing hundreds of years of life on the Pacific slope, hence there is yet a field for the explorer, and he is represented by a number of collectors who sell what they find to the various curiosity dealers; and so the household gods of the ancients are distributed all over the country. The old graveyards are found all through the Southwest. In many instances the dead were evidently buried either in the huts or in the very town where people lived. This was illustrated at Avalon, Santa Catalina Island, where a large Indian town of unknown antiquity was situated. When the writer first visited the island fifteen years ago, a large black spot could be distinguished to the right of the bay of Avalon, or to the north, some distance offshore. It was perfectly black and was, as may be assumed, a typical kitchen-midden, a townsite on which fires had been built and people had cooked and lived, possibly for ages, so long, in any event, that the ground had been stained and burned black.

When a native at Santa Catalina, or Pimugna, as it was called, died, he was buried in a shallow grave in or near his hut, and all his household goods were placed by his side—mortars, pestles, fish hooks, and other objects; and so many were buried here that at first it was but necessary for collectors to turn over the black sand to find mortars, pestles, and skeletons all mingled in strange confusion. Hundreds of objects have been taken from this locality, and every time an excavation is made at some places, stone implements are unearthed, telling the interesting story of what was really a California Stone Age. The writer, due to the courtesy of the Banning Brothers, owners of this island, made a superficial ethnologic survey of the region some years ago,



Sand Covered With Broken Implements at San Nicolas.

locating town, village, or camp sites, finding forty or more. The largest was at Avalon; another was at Descanso Cañon; others at White's Landing, Empire, and Johnson's Landing, while perhaps the largest of all was at the Isthmus. Here the dead were buried in layers, the writer, by trenching, tracing them to the fifth, which apparently rested on hardpan. The investigations here were interesting, as it was an easy matter to tell exactly where the Spanish influence was felt. Thus in the lowest graves there were no iron implements, all the decaying objects being of wood, bone, or stone; but above this, each grave contained various articles—bell tongues of copper being the most common. They were evidently used as beads to hang about the neck; but in no instance was a bell found. Other iron objects were mattocks, rough files, sword or knife blades, and beads of various kinds common in Spain. From this it was estimated that the iron-bearing graves were two hundred or more years old, and those containing stone and shell alone much older, possibly prehistoric, as judging from the deposits or mounds and their size, these islands have been inhabited for centuries.



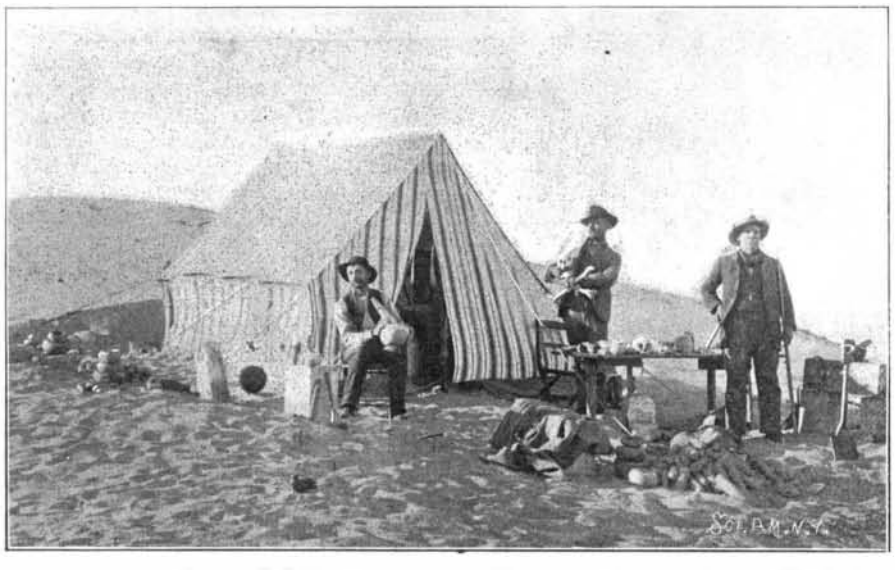
Implement Collectors on the Rocky Cliff, San Clement's Island.

In encircling the coast of Santa Catalina—about sixty miles—a townsite was found in almost every cañon mouth, and a large one at Little Harbor. In the interior there were many more, easily located by the broken abalone shells which had been taken from the coast. Excavating has been stopped on this island, and Avalon is now the headquarters for a number of men who spend the winter in searching the neighboring islands of San Clemente and San Nicolas. The former is about twenty miles to the southwest, and abounds in Indian townsites which are readily recognized. Here the dead were often buried in the sand. The writer while aiding in excavating a skeleton, now in the Smithsonian Institution, found a place where possibly fifteen or twenty bodies had been buried, judging from the broken skulls and limbs. This had been the location of a fight or battle, and the victims had been buried where they fell.

San Nicolas lies eighty miles to the northwest of Santa Catalina, and is a wind-swept region which until recently has been the Mecca of the collector. He packs up a supply of provisions for two or three months, and with boxes, paper, and gunny sacks, charters a vessel to land him, with the proviso that he is to be called for later on. Life at San Nicolas is that of Robinson Crusoe without any of the comforts. The island is almost a desert, a remarkable contrast to Santa Catalina and other islands. There are perhaps two springs, no trees, and a waste of sand that seems possessed of life, as it is ever moving, blown into the air by the ululant winds. At one point only is there a semblance of a harbor, a little cove into which the sea rushes violently at times. Here the goods are landed, and on the adjacent beach the tent of the collector and his partner is pitched. A more desolate place and a more insufferable existence can hardly be imagined, fog, wind, and sand almost interminably blowing. The tent has to be weighted down to keep it from sailing off into the air, and the life of the collector would not be a happy one were he not as a rule curiously adapted to it. Again, there is a fascination in finding ancient implements which keeps the average man keyed up. Much of the collecting at San Nicolas is done by the wind, that is, it blows the sand from one place to-day, covering another to-morrow, so that the entire surface of the island is ever changing.

The collector takes advantage of this, and patrols the sand, his keen eye on the alert for a new expos-

Uncovered by the Wind at San Nicolas.



Camp of an Indian Implement Collector. The Man on the Right Holds a "Finder."

A SINGULAR PROFESSION. "THE EXCAVATION OF BURIAL MOUNDS."

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ure; and so skilled do these men become, that they recognize a specimen if only a portion is exposed. They also use a staff with an iron point which is thrust into the sand as they move along, thus feeling for the objects, skillfully detecting them in this way. Another method, and perhaps the one most in vogue, is to dig a trench three or four feet deep directly through a mound and then work lateral sidings. The principal field for this work is a heap of sand, or a mound, almost a mile in length and eight or ten feet in height—a vast kitchen-midden upon which the natives of this desolate place lived for years. It is strewn with abalone shells, broken mortars and pestles, bones of human beings, in fact, every short distance are found evidences of this strange occupation. The articles as fast as collected are tossed in heaps, at night being taken to the camp and later sorted, wrapped and boxed. The vicinity of the camp is apt to resemble a Golgotha from the bones and skulls strewn about, there being a demand for human skeletons from various institutions in this country and Europe. The collection is made up of numerous articles. The largest are stone mortars weighing from ten to two hundred pounds, worn out by constant trituration with stone implements at first and later by the wear of the pestle. These mortars range from very small ones, used for paint, to the largest size and a variety of shapes. Among the ceremonial objects are clubs of stone from three to four feet in length. One in the possession of Mr. E. L. Doran, of Avalon, is a remarkable weapon, a tap from which would have crushed a human skull. In small boxes the collectors pack the beads, thousands of which are found, the gathering entailing a vast amount of labor.

The writer saw a skull uncovered at the Isthmus, Santa Catalina, in which a necklace had evidently been laid upon the face; the beads had in centuries found their way, through the decay of the bone in the eye sockets, into the skull, which held hundreds, as though they had been placed there. One of the most interesting finds of these collectors are what they term "jewelry cases." These are two large shells of haliotis, which have been reversed and joined, forming a box, the edges being sealed by asphaltum, quantities of which float ashore on all the islands. Upon shaking these boxes a rattling sound is heard, showing that something is within, and when the shell is pried open, resting in the pearly interior are found earrings of pearl, choice pearl beads, a small necklace of shells perhaps, and strange objects in stone—good luck stones, all of which were made from the choicest abalone shells. Doubtless these objects were the treasured possessions of some native maiden, and were sealed up in this manner and placed in her grave. Few objects of this ancient loot have such an attraction to the buyer as these, as each "case" is different, and few can resist the temptation to break open the shells.

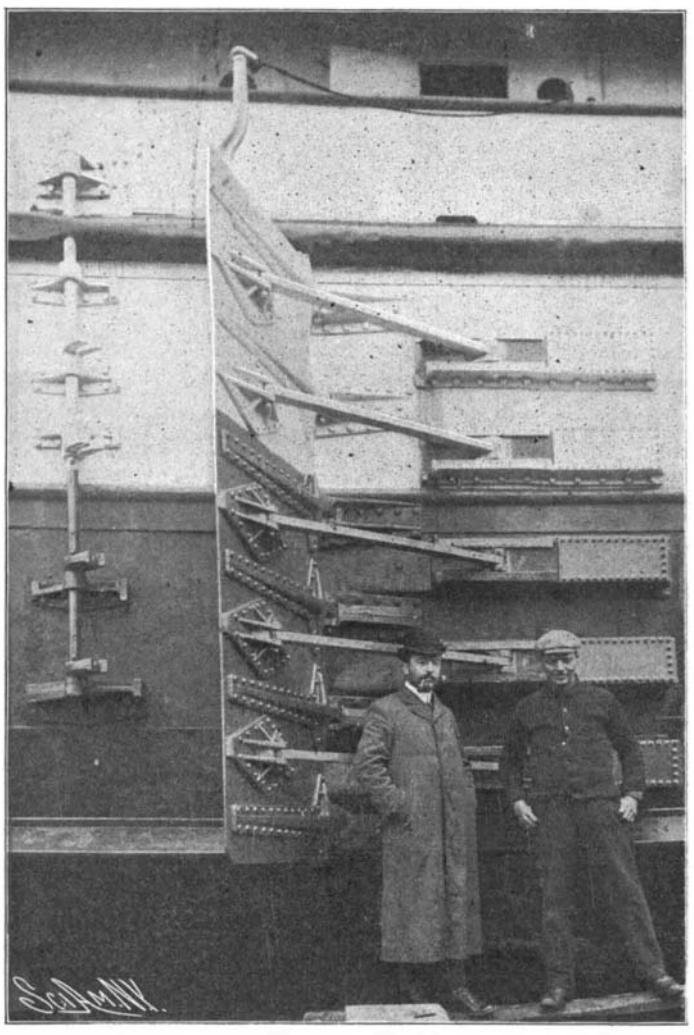
As the days go by on the collecting ground the pile of filled boxes and gunny sacks increases, and the curiosity hunters become wearied with the eternal monotony—sand everywhere, sand aloft in great whirls, now scudding along the surface, piling up against every obstruction, alternately changing the face of nature. The constant rush and roar of waves has become maddening, the lines of shags and their strange movements have long since ceased to be an amusement, and the isolated men watch and count the days when the boat shall appear; finally, when it does, they shake the dust of the island literally from their clothing and return to Avalon to take up their summer avocations as boatmen or oarsmen. The finds are divided *pro rata*, the partnership is dissolved, and the highest bidder among the curiosity dealers obtains the collection, which in a short time is spread broadcast over the country.

Artificial Electrification of the Earth Globe.

The fact that, in spite of the curvature of the earth's surface, electrical waves are capable of traveling over enormous distances is scarcely to be accounted for on current views as to the mechanism of wireless telegraphy. E. Lecher has shown that a possible explanation of these phenomena is afforded by the hypothesis that the waves are propagated on the conducting surface of the earth in the same manner as electric oscillations will be transmitted along conducting wires. This explanation, which some time ago did not exclude other hypotheses, seems the only admissible one at the time being, on account of Marconi's radiotelegraphic transmission through the Atlantic. Herr Lecher therefore in a lecture recently delivered before the Prague German Mathematical Society, once more discusses this interesting question, exposing his previous theory in a form essentially identical, though somewhat simplified.

The question as to whether it would be possible to produce telegraphic signals at distant points, by electrifying the earth globe in an artificial way, though involuntarily arising, has so far been put off because of the difficulty, nay impossibility, of a similar undertaking. Yet, in a certain sense, there occurs such an artificial electrification of the earth in wireless telegraphy. After being thrown away from the earth by the transmitting antenna and traveling through the latter a way superior to 50 meters, either electricity will return to the earth to be repelled once more, and soon. As every antenna is connected to the earth either directly or by means of a condenser, the earth at this point will be charged periodically alternately with positive and negative electricities by the oscillations produced in the long vertical wire, termed antenna. Now these electrical charges will be propagated along the surface of the earth in a manner perfectly analogous to the transmission of water waves on a water surface. The receiving antennæ will thus as well receive alternately positive and negative charges that will give rise to oscillations influencing the coherer.

In order to understand these phenomena, it is neither necessary to discuss the question of ether nor that of ether waves, nor will Maxwell's theory necessarily have to be resorted to. That, in fact, these alternative charges of the different points of the surface will be attended by vertical oscillations in the dielectricum, that, to put it in the language of that theory, ether waves will be produced, goes without saying; with the explanation suggested by Lecher, however, this is a fact of only secondary importance.



SHIP BRAKE FOR PREVENTING COLLISIONS AT SEA.

The following experiment is suggested by this theory: Two points *a* and *b* being given on the surface of the earth, so that *a b* is in the direction of the transmitting antenna; if *a b* be equivalent to one-half of the wave-length, *a* and *b* will alternately be charged positively and negatively with the same period as that of the oscillations themselves. Placing in *a* and in *b* horizontal metal plates of a certain extent and uniting both points by means of a horizontal wire, will give rise to electric oscillations in this wire.

A similar experiment would be interesting not only as affording a means of testing Lecher's views; supposing that electrical waves could be detected in this way, this scheme would show some technical advantages as well. The wire *a b*, in fact, will act only when accurately directed toward the transmitting station. Moreover, it would be possible to devise similar contrivances, affording a means of testing the absorption of oscillating charges by the earth and sea.

A. G.

Dispatches from Widewater, Va., state that Prof. Langley is still pursued by the ill-luck which has marked his recent experiments with his aeroplane. On September 3, a spark coil gave out, a valve broke in the motor, and its erratic working seemed to indicate that another failure might be looked for. The next day the port propeller, while revolving at a high rate of speed, succeeded in wrecking itself among the rods and bars of the machine.

A SHIP BRAKE.

Mention has already been made in these columns of the fact that the Canadian government has recently equipped one of its vessels—the steamer "Eureka," plying on inland waters—with a ship brake; and we are now enabled to present an illustration which shows very clearly the nature and operation of the device. As the name indicates, the brake is intended to check the speed of a vessel. It can also be utilized to assist in turning about in a limited shipway. During a recent trial made in the St. Lawrence River, near Montreal, the steamer was driven ahead at an indicated speed of eleven knots an hour. Steam was then shut off, and, simultaneously, the brake on each side opened. The vessel came to a full stop within a distance equal to her own length. The brakes were then closed, the vessel sent ahead until the original rate of speed was attained, when the engines were reversed and the brakes opened, with the result that all headway ceased after she had gone but fifty feet—about half her length. In maneuvering the "Eureka" at full speed, she was turned also within her own length, with one brake thrown open. An examination of the hull and brake mechanism after the tests showed apparently no harmful strain or other damage, and in operating the brake, no jar or vibration was observable by those on board.

This new form of brake, as will be seen from the illustration, is placed on the sides of the hull, and in its construction and method of attachment to the ship resembles somewhat an ordinary rudder. It extends downward from the extreme load line of the vessel to the bilge keel, convenience of stowing and handling the necessary area being secured by making the brake relatively deep in proportion to its width. The "gate," as it is called, consists of a stout plate of steel, heavily reinforced, which is hinged verticaly to the vessel, and normally, when not in use is folded snugly against the side of the ship. A series of heavy steel struts are pivotally attached to the back of the gate near its outer edge, and also to a series of sliding plates which are arranged to move horizontally in covered ways, built into the structure of the hull. When the gate is folded forward against the side of the ship, the sliding plates are, of course, at the forward end of the covered ways, but as the gate is released, and thrown open by the pressure of the water as the ship travels forward, the sliding plates travel backward in their pockets and compress the water that is contained within the covered ways. At the rear end of these ways is a number of orifices, which allow the water to escape gradually as the gate, in opening, pushes the slides backward. The forward edge of the gate is secured in place, when the brake is not in action, by a series of catches arranged on a vertical shaft. The rod on which the gate is hinged is provided with a bevel gear by which the gate may be started to open. The method of operation is as follows: When it is desired to stop the vessel suddenly, as in the event of a collision, or when making a landing, the catches that hold the forward ends of the gate are released, and by means of the bevel gear, the gate is slightly opened. The pressure of the water then catches on the forward edge of the gate, swings it out to the full-open position, sudden jar or shock being prevented by means of the water cushions at the back of the slides. The movement of the brake can be controlled entirely either from the bridge or from the engine room, as may be desired.

Simultaneous Manufacture of Sodium Nitrite and Massicot.

The lead and sodium nitrate employed must be quite pure. The lead especially should be free from antimony and copper. The sodium nitrate should not contain more than 1 per cent of impurities. The operation is conducted in a cast-iron vessel furnished with an agitator. At first 350 kilogrammes of sodium nitrate are introduced and heated to the fusing point, and the temperature of the bath raised to 400 deg. The lead is then added in successive portions, and the agitator put in motion. When about 950 kilogrammes of lead have been introduced, the agitator commences to rise, which indicates that the resistance of the bath is becoming too strong. The addition of the lead is then stopped and the agitation continued to end the reaction. The mixture is afterward flowed into slabs about 1 meter in length by 0.50 by 0.10 meter. These slabs are broken and treated with water, which dissolves the nitrite and deposits lead oxide. The solution of nitrite is evaporated to crystallization and yields crystals of 98 or 99 per cent of purity.

The lead oxide is separated from the lead by levigation, dried, calcined, and packed. The lead, which remains as a residue of the levigation, is introduced into a reverberatory furnace having two chambers, giving a temperature of 700 or 800 deg. C., where it is oxidized and yields litharge.—La Revue des Produits Chimiques.

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THE SEAS OF FOG.

BY EMILE GUARINI.

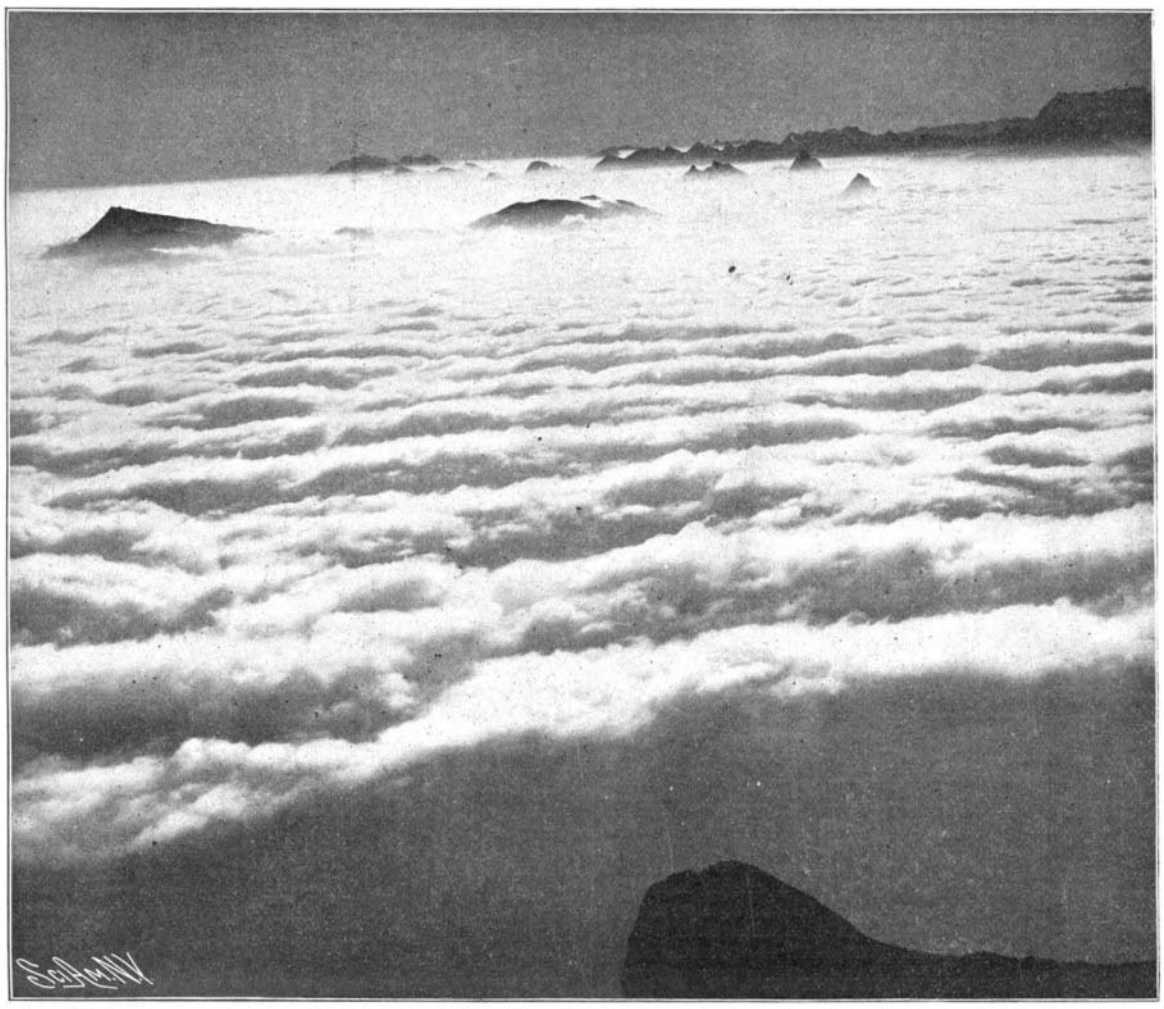
I have, on more than one occasion, had the pleasure of seeing Switzerland, and, as is indispensable for the tourist (without regret, however), of climbing up some of those summits for which the little Helvetian republic is celebrated. When I say "climb," I employ a very improper word. In Switzerland, in fact, there are so many cable railways, which, for a relatively reasonable fare, carry a person without fatigue to the summit of the highest mountains, that he must be smitten with intense emotion and be fond of fatigue and danger to induce him to run the risk of ascending to almost inaccessible peaks at the cost of thousands of useless efforts.

On foot, then, or upon railway (and there is even an advantage upon railway, since it is possible for a person to contemplate at his ease and without any distraction), the spectacle to be enjoyed, at the summit of the mountains especially, is wonderful, unique.

The two mountains of which the ascent is made by preference are the Rigi and Pilatus, both on the Gothard line, upon the route that leads from Brussels to the beautiful land of Italy. From the top of these mountains, the rising of the sun is one of the grandest spectacles that could be imagined, and, even without sunrise, the panorama that unfolds itself before the eyes leaves the spectator mute and enraptured in the presence of these gigantic manifestations of nature. For several miles round about there are unveiled, in a harmonious whole, villages hanging on to the rocks, hills covered with forests, deep and umbrageous valleys, and sparkling glaciers; and amid this titanic chaos, appears and then disappears the railway, which is scarcely perceptible upon these colossal masses.

But in order that this spectacle may be enjoyed, the fog must not come into play, since in such a case nothing can any longer be seen, or, rather, what is seen is a very different thing from what the tourist came to contemplate upon the desert summits. I had a proof of this the last time that I ascended the Rigi. In measure as I ascended, the weather became worse and worse. Rain, wind, glacial temperature, and fog—all were in evidence. And yet this unfortunate state of things was of some good. Scarcely had I reached an altitude of 3,900 feet, when I saw spread out at my feet something like a sea, of which the huge waves rolled one over another, while here and there the points of the neighboring summits emerged like rocks and islets. It was the "sea of fog" that chance in mischance—that hazard—was spreading out before my eyes.

The accompanying figures are reproductions of two photographs that were particularly successful. They were not taken from the Rigi, but from Mt. Pilatus. I am indebted for them to the courtesy of the manager of the railway that ascends this mountain. One of them gives a view of the sea of fog at an altitude of 3,280 feet and allows a face view of the panorama of the Bernese Alps to be seen. The other shows the sea rising 1,960 feet higher. A few summits, a few ridges, that of the Rigi-Kulm among them, alone emerge from the flaky immensity.



A SEA OF CLOUDS.

ABOVE THE CLOUDS.

Foreign Engines at St. Louis Fair.

The Pennsylvania Railroad announces that it has ordered locomotives from France, Germany, Russia, and England for exhibition purposes at the St. Louis Fair next year, and it may include engines from Japan and Italy. It is the idea of the railroad company that in making this exhibit they will show the superiority of their own engines, and incidentally pick up any of the good points which they may possess. After the Fair, the engines will go into regular service on various divisions of the road.

Chemistry of Soils as Related to the Yield of Crops.

The Secretary of Agriculture announces that the Bureau of Soils has just finished an exhaustive investigation of the chemistry of soils as related to the yield of crops. The results indicate that practically all soils have sufficient available plant food for normal crop yields, and that this supply is constantly maintained through natural agencies in the soils dissolving the material of the soil grains. The difference in yield is dependent upon the condition and kind of cultivation and rotation of crops, maintaining certain necessary physical conditions in the soil, under which this plant food can be used by the crop. A bulletin has just gone to press giving the details of the investigation, and discussing the influence of climate, texture of soil, rotation, fertilizers, and soil management upon the yield of crops. The work is based upon analyses by new and exceedingly sensitive methods, by which the amount of plant food in the soil moisture itself, which is the great nutritive solution for the support of crops, has been determined, and not by digesting the soils in acids which attack the inert mineral matter of the soils.

While the conclusions appear to be in conflict with the opinions held for so many years by agricultural chemists, they are in strict conformity with the experience of good farmers in all countries, and with actual facts which have long been established by agricultural chemists. The fertility of the soil is thus shown to be due to physical causes which control the supply of water and plant food which it contains, as the soil moisture in all cases appears to be about the same in composition and concentration. The fertility is therefore controlled by a physical cause, and a chemical examination of a soil can not be expected to indicate the yield of a crop. It is believed that a simple physical method will be devised for determining the relative fertility of soils.

The electric working of the railway line between Gallarate and Milan has been so successful that the system is to be extended to other branches. The length at present worked electrically is 48½ miles. There are from 70 to 80 trains per day, 12 of which make the run from end to end in 77 minutes, inclusive of stops. The continuous-current system is used, and the motor cars run daily between 250 and 280 miles each. The express trains on the 25-mile section between Milan and Gallarate take only 30 minutes for the run. Power is obtained from a central station at Tornavento, and distributed on the three-phase system to a number of sub-stations suitably distributed over the whole length of the railway.

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RECENTLY PATENTED INVENTIONS.

Apparatus for Special Purposes.

COUNTER-PRESSURE RACKING AND BUNGING APPARATUS.—H. REININGER, New Orleans, La. In the present case the object of the invention is to provide a new and improved apparatus for racking and bunging beer and other carbonated liquids from a storage cask or tank into smaller packages without loss of carbonic acid or waste of liquid under treatment.

Engineering Improvements.

MOTOR DRIVEN BY WATER-CURRENTS.—T. A. MACDONALD, Paterson, N. J. It is the object of this invention to provide an improvement in the class of motors which are adapted for utilizing the force of flowing water by transforming it into electrical energy or for driving machinery of any kind. It is well known to those acquainted with such motors that they have proven generally unsatisfactory for several reasons, and are hence rarely used. This device avoids the chief defects of its predecessors.

VAPORIZER FOR EXPLOSIVE-ENGINES.—C. F. PEARSON, Chicago, Ill. This improvement has reference to a vaporizer intended especially for use in connection with internal-combustion engines, and the leading feature of the invention lies in improved means for imparting a rotary movement to the air, thus effecting a more immediate association between the air and the oil.

TUNNEL CONSTRUCTION.—D. PHILLIPS, Pony, Mont. In this patent of Mr. Phillips the invention has reference to improvements in the method of constructing tunnels under and on the bed of a stream, an object being to provide means whereby a submerged tunnel may be rapidly and economically constructed.

WELL-DRILLING APPARATUS.—C. S. WRIGHT, Quaker City, Ohio. In this case the invention relates to an apparatus for drilling wells; and it lies in certain novel features of construction and arrangement concerned with the mast, the walking-beam and the drums for operating the bull-line and sand-line. Means are provided whereby the entire machine is placed under the control of a single operator.

Hardware and Tools.

KNOCKDOWN MITER-BOX.—A. C. BIRGE, Cleveland, Ohio. The inventor's purpose in this case is the provision of a miter-box of very simple and practical construction which will permit any kind of a hand-saw to be used in the box and which may be easily and quickly taken down and packed in convenient and compact form for transportation and as easily set up.

OPERATING DEVICE FOR WINDOW-BLINDS.—A. C. PRICE, Russellville, Pa., and W. J. CONNOR, Bart, Pa. This invention relates to improvements in devices for operating window-blinds or shutters, the object being to provide a device of this character by means of which window-blinds may without opening the window be opened and closed and locked in either of such positions or locked at any desired opening or bowing.

SNAP-HOOK.—J. A. GAVITT, Pendleton, Ore. The principal feature of this invention lies in the tongue and means for mounting it and holding it in either of its two positions (opened or closed), these means consisting in a slightly-yielding guide attached to the tongue and embracing the shank of the hook, whereby to mount the tongue to slide toward and from the bill of the hook, and in interengaging surfaces on the tongue and shank which act to hold the tongue in either of its positions.

LOCK.—T. H. REA, Cambridge, Ohio. In Mr. Rea's patent the invention has reference to locks of the kind used upon doors, gates, etc. More particularly the inventor's object is to produce a neat, simple, and efficient form of lock in which the weights of certain parts enter to some extent as factors in the working of the lock.

SASH-LOCK.—J. H. CLEMENTS, Coperas Cove, Texas. An object in this invention is to provide a sash-lock that is simple, cheap, and effective in operation. A further object is to provide a device which may be applied to a window-frame to lock the sash without defacing the frame or sash and one which may be applied to windows already in use. Another object is to do away with the use of weights to hold the sash at any elevation and provide in their place a device equally as effective.

CLAMP.—N. K. TEILBORG, Wausa, Neb. The invention relates to wood-working; and its object is to provide a clamp which is simple and durable in construction, very effective in operation, arranged for convenient use on carpenters' and wheelwrights' work-benches or sawbucks and other devices, and arranged to securely clamp a board or other piece of work in position for the mechanic to work on it.

HANDSAW.—R. F. E. OKRASSA, Antigua, Guatemala. The claim of this invention for an object is the provision of a new and improved handsaw which is simple and durable in construction, readily adjustable for accommodating saw-blades and for giving the desired tension to the saw-blade, and arranged to allow a convenient removal of a worn-out blade and insertion of a new one.

Heating and Ventilating.

VENTILATOR FOR LEADER-PIPES.—G. M. VROOME, New York, N. Y. In this case the invention refers to ventilators for pipes, and more particularly for pipes of the type known as "leaders" and used for conducting water from roofs of buildings to the ground or sewer. The general object is to enable the interior of the leader to be dried quickly, thereby preventing damage to the sheet material of which the leader is composed.

Of Interest to Farmers.

KNIFE-CYLINDER FOR CORN HUSKERS AND SHREDDERS.—E. WISNER, Caro, Mich. The purpose in this improvement is to provide a knife-cylinder so constructed that the knives will be firmly and simply held therein and so that any one or all of the knives may be conveniently removed to be sharpened or when damaged and readily and quickly replaced without removing the cylinder from the machine and without removing any portion of the knife retaining or locking mechanism from the cylinder.

Machines and Mechanical Devices.

CENTRIFUGAL MACHINE.—J. D. KENNON, Duke, Texas. Mr. Kennon's invention relates to centrifugal machines employed as sugar-driers to separate the molasses from the crystallized sugar by centrifugal action within a rapidly-rotating and perforated cylinder. The invention consists in means for introducing the sugar, washing it, and then discharging it in a very convenient, rapid, and effective way.

FLOUR-PACKER.—C. W. GEIGER, Kirkersville, Ohio. This improvement is in the nature of an attachment to a flour-packer of that form in which a barrel or sack is raised upon a platform until it slips over a filling-tube in which rotary packing devices operate to pack the flour from a hopper into the barrel or sack. The platform is maintained in an elevated position by a brake-wheel and brake, and when the packing is complete the driving-gears which operate the packing devices are disconnected by a shipper-lever, the brake-wheel is released, and the platform, with the barrel or sack, descends to the floor.

BALING-PRESS.—W. C. SPURGEON, Milroy, Indiana. A main object in this invention, which relates to improvements in baling-presses for hay or light material, is to provide in connection with a press a simple means to facilitate the applying of the binding-wires—that is, to provide in connection with a baler a device by means of which the operator standing at one side of the machine may apply the wires, thus reducing the time usually required in the operation.

VOTING-MACHINE.—G. JOHNSON, Pigeon-cove, Mass. The intention of this inventor is to provide a new and improved voting-machine arranged to permit a voter to vote by manipulating certain mechanical devices or by resorting to writing, to allow voting a straight ticket or for candidates individually, to allow separate voting by females, and voting for amendments, licenses, etc.

Pertaining to Vehicles.

SWINGLETREE.—P. KRALL, San Francisco, Cal. The aim of this improvement is the provision of novel features of construction for a swingletree which absorb the jar and cushion the shock usually communicated to the shoulder of a draft-animal when attempting to start the movement of a heavy load or when moving a loaded vehicle over a rough road.

RUNNER ATTACHMENT FOR BICYCLE-FRAMES.—F. DUPRAS, Marquette, Mich. It is the object of Mr. Dupras in his invention to provide an improved runner attachment for the ordinary bicycle-frame, the attachment including a driving mechanism which is operated by the ordinary chain-and-sprocket gear employed on bicycles.

Miscellaneous.

STORE-FRONT SASH.—J. B. PHELPS, Mendota, Ill. Among other objects this inventor seeks to provide an improved mounting which holds a glass securely in place without the use of putty, allows for expansion and contraction of the glass and for the settling of the store-front or sash-frame, so as to minimize the tendency of the glass plate to become broken, to permit the plate-glass to be mounted without cutting the glass if its edges are not true, to make provision for fitting two or more plate-glass panes to an angle corner or post, and to provide for circulation of air through the show-window and on the inner surface of the plate-glass.

FIXING TRAY.—G. T. MCKINNEY, Walla Walla, Wash. In this patent the invention relates to improvements in trays of the character generally known as "photographic" trays and employed for the purpose of fixing photographic plates or films. The principal object in this case is to provide a device of the character specified, which will enable plates or negatives of various sizes to be thoroughly fixed without employing a great amount of solution. Means are provided to prevent injury to negatives, and also to avoid using a large number of separate trays.

CURTAIN-DISPLAY APPARATUS.—M. J. BEBB, Xenia, Ohio, and E. G. EATON, Athens, Ohio. These inventors have obtained a former patent for a curtain-display rack so constructed as to support curtains or other fabrics and facilitate their display. Their present invention has for its object to provide an attachment for such rack, its functions being to furnish an improved support for the dust-curtains, which protect the display-curtains, and to provide a bearing for the upper end of the rod or shaft upon which the arms for supporting the displaying-curtains are journaled.

WINDOW OR DOOR SCREEN.—A. S. WINN, Escanaba, Mich. The purpose in the present case is to provide such a construction for the tops and the partition-moldings of any type of window or door screen that flies or other winged insects may readily pass out from a room, but will be effectually prevented from flying or crawling in through the openings prepared for their exit.

SPINNING-TOP.—C. MARX, New York, N. Y. The invention has reference to games and toys, consists of novel features and parts and combinations of the same, and has for its object the provision of a new and improved spinning-top arranged to allow spinning of a series of tops at one time by one exertion of the operator.

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FOR SALE.—United States, Canada and Great Britain patents that will control the steam hose trade. L. T. Foreman, Omaha, Neb.

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Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

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PATENT FOR SALE ON ROYALTY.—The invention provides means for preventing bolts from turning when screwing nuts on same, and for preventing nuts from becoming accidentally loosened. Patent No. 732,817. Address Ole O. Bahle, Fergus Falls, Minn.

Inquiry No. 4601.—For a machine for cleaning carpets, etc., with and without taking them up.

WANTED.—Capable and experienced man to take entire management of plant employing 1,500 men manufacturing light machinery specialty of world renown. Mechanical engineer preferred, but business qualifications and knowledge of men essential. Unusual opportunity for a man of tact, broad, liberal education and large caliber. Applications treated in strictest confidence. Address Manager, Box 773, New York.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9174) F. M. L. asks: Does the constellation known as the "Big Dipper" make a complete revolution about the north star during the year? At present the "handle" points down toward the earth during the early evening. Does it ever come into such a position that the imaginary contents would be spilled out? Appreciating the favor of a reply. A. The Great Dipper makes a complete revolution around the north star every twenty-four hours. If you will observe at eight o'clock and for several hours after that time, you will see its change of position. When the basin is at its lowest it will hold water, but in twelve hours it will be inverted and will be bottom side up, nearly up to the zenith. There is also an annual motion around the north star. If you will observe at eight o'clock through a year you will see that it slowly changes its position as referred to the north star as a center, from week to week, so that in a year it will occupy all positions on a circle of which the north star is the center.

(9175) F. A. A. writes us: I would like to ask if you could make a list of books that you publish on astronomy in their order of advanced lessons for a student, such as starting with an elementary course and continuing to an advanced one? I am very anxious to study astronomy in all its forms and am not posted on instruction books if there are such. A. We would advise that you begin your reading of astronomy with Todd's New Astronomy, price $1.50. After that might come Todd's Stars and Telescopes, price $2. Next Young's General Astronomy, price $3.50. This last will involve more mathematics than the first books named. After these are mastered you should take some work on practical astronomy and the use of the instruments of an observatory. You cannot become an astronomer except by working in an observatory and handling the instruments. We can at a later time advise you still further as to books, but as new and better ones are all the time appearing it is not advisable to give too many at present.

(9176) L. A. W. says: I have a one-story cottage 24 x 36, ground floor divided into five rooms, with a vestibule, south front, 9-foot ceilings. Cellar 16 x 20 under center of house, brick chimney from ground up. Will you kindly advise me the cheapest method of heating—hot water, steam, or hot-air furnace—from a standpoint of amount of coal consumed, and of the three methods which is the most sanitary? A. The comparative economy and convenience of hot-air, hot water, and steam-heating plants depend largely on the size and character of the buildings in which they are used, and all three systems we believe may be equally sanitary if they are properly installed in buildings to which they are adapted. In your one-story cottage we believe that you will probably find the hot-air furnace the cheapest and most economical of coal. It will also tend to improve your ventilation and thus help to keep the air in your rooms pure.

(9177) H. B. A. asks: I have a small telescope, the front lens of which measures about 1¼ inches. Will you please tell me how I can find the magnifying power of it? A. The simplest way to measure the magnifying power of a small telescope is to look through it with one eye at a brick wall and with the other eye directly at the bricks. A little practice will enable you to see the bricks with both eyes at once. Now count the bricks seen with the eye directly, which one brick, as seen through the telescope, covers. This is the magnifying power.

(9178) N. J. P. asks how to etch on cutlery. A. For etching on cutlery a ground wax is required, composed of equal parts asphaltum, Burgundy pitch and beeswax, melted together and thoroughly incorporated. In applying it, use a dabber, or ball of cotton covered with silk. Warm the piece of cutlery so that a stick of the wax will readily melt by touching. Smear a small quantity of the wax

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on the blade or articles, and dab it evenly all over the surface. When cold, scratch the required design or name on the surface and touch the parts with acid (nitric acid 1 part, water 4 to 6 parts), using a camel's hair pencil to cover the surface and bring the acid into contact with all the lines. In a few minutes the biting is done. Dip in hot water to wash off the acid, and the surface may be cleaned by wiping with benzine. Another way is to make a varnish of asphalt and turpentine, with a few drops of linseed oil to make it tacky. Have a rubber stamp made of the required design, with a border, so as to stop off around the design. Stamp the goods, and with some of the varnish thinned down with turpentine and a brush stop off the surrounding parts; or surround the design with a small rim of beeswax, and apply the acid as above.

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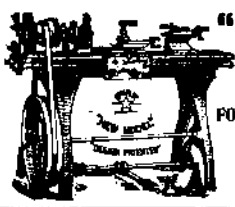

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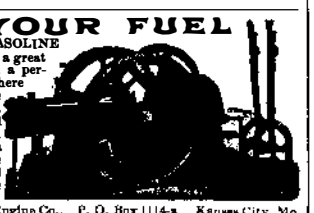

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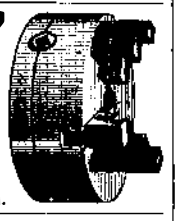

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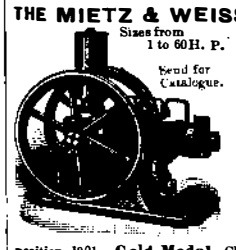

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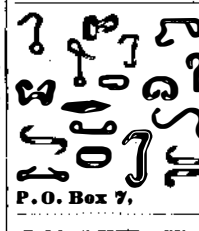

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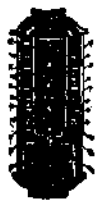

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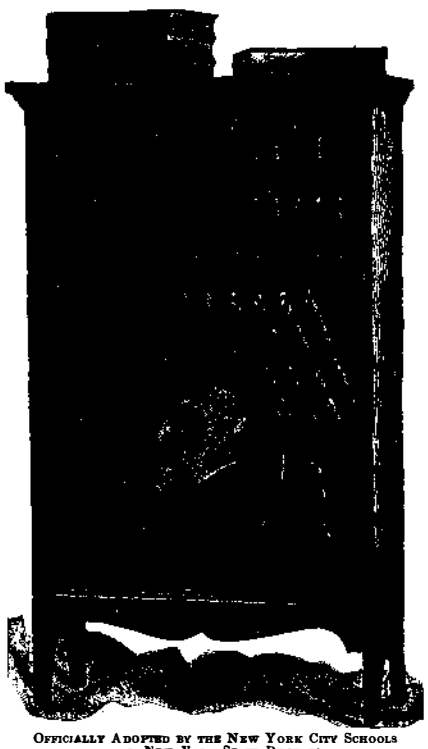

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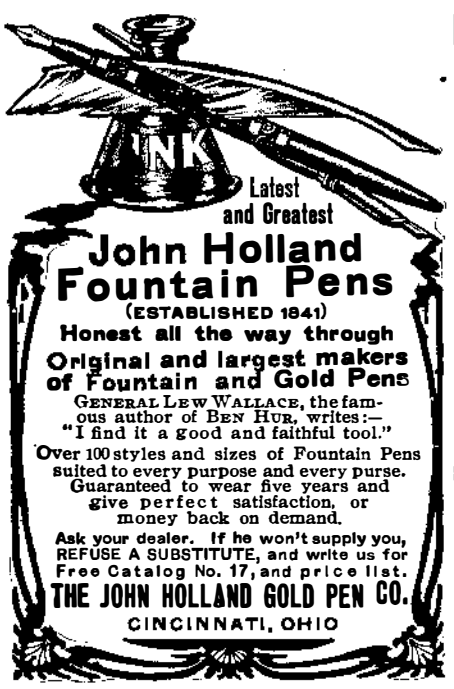

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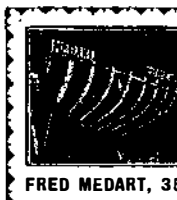

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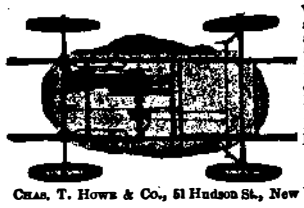

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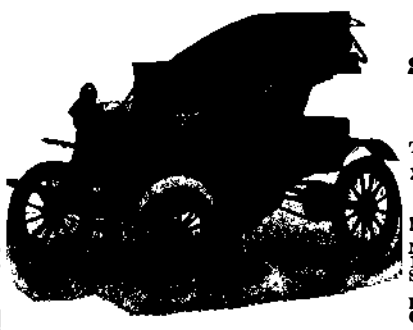

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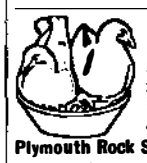

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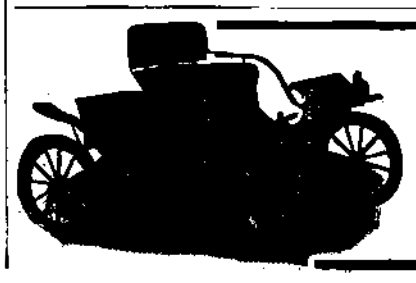

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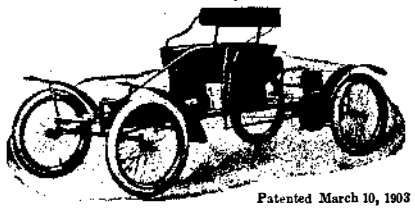

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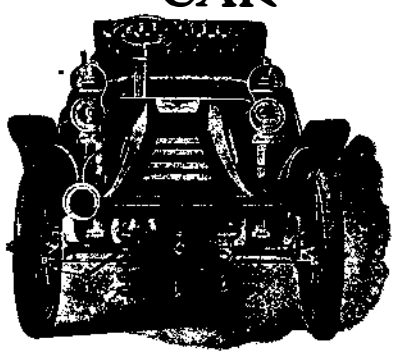

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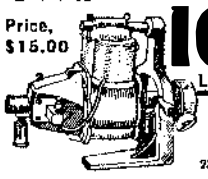

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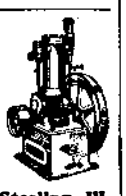

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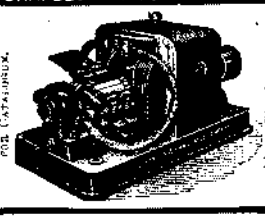

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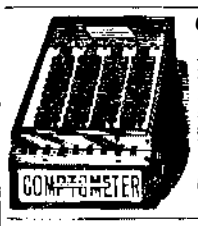

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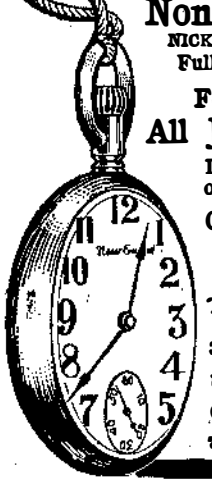

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